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Southwestern Region/Carson National Forest

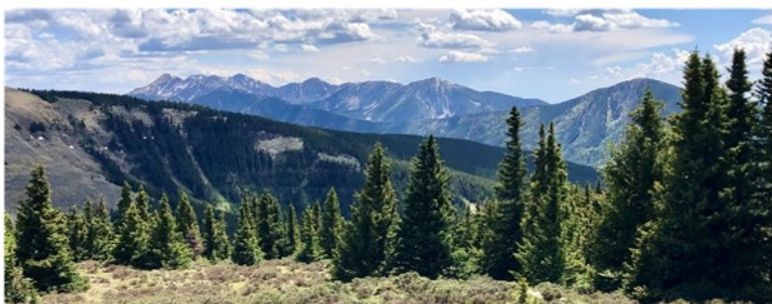
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Final Environmental Impact Statement for the Carson National Forest Land Management Plan

Volume 1: Chapters 1 through 3

Rio Arriba, Taos, Mora, and Colfax Counties, New Mexico



For More Information Contact:

Peter Rich, Forest Planner
Carson National Forest
208 Cruz Alta Road
Taos, NM 87571
(575) 758-6200

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Final Environmental Impact Statement for the Carson National Forest Land Management Plan

Lead Agency: United States Department of Agriculture (USDA) Forest Service

Cooperating Agencies: Colfax County, Colfax Soil and Water Conservation District, County of Mora, East Rio Arriba Soil and Water Conservation District, Jicarilla Apache Nation, New Mexico Acequia Commission, New Mexico Department of Agriculture, New Mexico Department of Game and Fish, New Mexico Department of State Forestry, New Mexico Environment Department, New Mexico Land Grant Council, Picuris Pueblo, Rio Arriba County, San Juan Soil and Water Conservation District, Taos County, Taos Pueblo, Taos Soil and Water Conservation District, Upper Chama Soil and Water Conservation District, Western Mora Soil and Water Conservation District

Responsible Official: James Duran, Forest Supervisor
Carson National Forest
208 Cruz Alta Road
Taos, New Mexico 87571

For Information Contact: Peter Rich, Forest Planner
Email: peter.rich@usda.gov
Telephone: (575) 758-6200

Abstract: This programmatic final environmental impact statement discloses the detailed analysis of five alternatives for revising the 1986 Forest Plan. The analysis documents anticipated progress toward desired conditions as well as potential environmental and social consequences of implementing each alternative. Alternative 1 is the no-action alternative, which is the 1986 Forest Plan, as amended. Alternative 2 is the proposed revised plan and is reflected in the accompanying Land Management Plan for the Carson National Forest. Alternative 3 maximizes access and commodity utilization. Alternative 4 maximizes natural processes. Alternative 5 maximizes wilderness recommendation.

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Commonly Used Acronyms

BLM	Bureau of Land Management
CEQ	Council on Environmental Quality
CFR	code of Federal regulations
DEIS	draft environmental impact statement
DBH	diameter at breast height
EIS	environmental impact statement
FEIS	final environmental impact statement
FS	Forest Service
FSH	Forest Service handbook
FSM	Forest Service manual
GIS	geographic information system
MMBF	million board feet
MMCF	million cubic feet
NEPA	National Environmental Policy Act
NF	national forest
NFS	National Forest System
NHPA	National Historic Preservation Act
NM	New Mexico
NMDGF	New Mexico Department of Game and Fish
USDA	U.S. Department of Agriculture
USDI	U.S. Department of Interior
USFWS	U.S. Fish and Wildlife Service

Plan Codes

Plan components are represented using their alphanumeric identifiers (plan codes) as brief way to reference the plan. The plan codes are made up of four parts:

- The level of direction: FW (forestwide), DA (designated area), or MA (management area);
- The resource (e.g., VEG for All Vegetation or WFP for Wildlife, Fish, and Plants);
- The type of direction (DC = desired condition, O = objective, S = standard, and G = guideline); and
- A unique number (numerical order starting with 1).

Abbreviations used for plan codes

Code	Resource or Term	Code	Resource or Term
AIR	Air Resources	NTRL	National Scenic, Historic, and Recreational Trails
ALP	Alpine and Tundra	O	Objective
ASP	Aspen	PART	Partnerships
BOT	Botanical Areas	PJO	Piñon-Juniper Woodland
BP	Bristlecone Pine	PJS	Piñon-Juniper Sagebrush
CAM	Caves and Abandoned Mines	PPF	Ponderosa Pine Forest
CDNST	Continental Divide National Scenic Trail	REC	Recreation
CR	Cultural Resources	RHC	Rural Historic Communities
CRF	Cliffs and Rocky Features	RMZ	Riparian Management Zones
DA	Designated Areas	RWMA	Recommended Wilderness Management Area
DC	Desired Condition	S	Standard
DEVRES	Developed Winter and Summer Resorts	SAGE	Sagebrush
EWSR	Eligible Wild and Scenic Rivers	SAMA	San Antonio Management Area
FAC	Facilities Infrastructure	SCEN	Scenery
FFP	Forestry and Forest Products	SFF	Spruce-Fir Forest
FIRE	Wildland Fire Management	SL	Soil Resources
FRT	Federally Recognized Tribes	SNS	Springs and Seeps
FSR	Forest and Shrub Riparian	STM	Streams
FW	Forestwide	SU	Special Uses
G	Guideline	TFA	Transportation and Forest Access
GMMA	Grassland Maintenance Management Area	VEG	Vegetation
GRZ	Livestock Grazing	VFSYU	Vallecitos Federal Sustained Yield Unit
IRA	Inventoried Roadless Area	VVMA	Valle Vidal Management Area
JICMA	Jicarilla Natural Gas Management Area	WB	Waterbodies
LAND	Lands	WFP	Wildlife, Fish, and Plants
MA	Management Area	WHT	Wild Horse Territories
MCD	Mixed Conifer, with Frequent Fire	WILD	Existing Wilderness
MCW	Mixed Conifer, with Aspen	WR	Wetland Riparian
MM	Minerals and Mining	WSW	Watersheds and Water
MSG	Montane Subalpine Grassland	WSR	Existing Wild and Scenic Rivers
NIS	Nonnative Invasive Species	ZOO	Zoological Areas
NSBW	National Scenic Byway		

Summary

The Forest Service has prepared this final environmental impact statement (FEIS) to describe and analyze in detail five alternatives for managing the Carson National Forest (hereinafter referred to as “the Carson”). The FEIS describes the affected environment and discloses environmental effects of the alternatives.

Proposed Action

To comply with the National Forest Management Act and address changes that have occurred over the past 33 years, the Carson proposes to revise its current forest plan (hereinafter referred to as “the 1986 Forest Plan”), which guides programmatic management of the approximately 1.5 million acres it administers. The revised land management plan (hereinafter referred to as “the plan” or “the revised plan”) will address new information and concerns raised since the 1986 Forest Plan was published; meet objectives of Federal laws, regulations, and policies including the National Forest Management Act and the provisions of the 2012 Planning Rule; address anticipated changes in management needed over the next 15 years based on the assessment of current conditions and trends; provide for clear direction in the form of desired conditions, objectives, standards, guidelines, suitability, management areas, and monitoring; incorporate the best available scientific information; and provide a framework for adaptive management.

Purpose and Need

In preparation for plan revision, the Carson identified guidance in the 1986 Forest Plan that is working, new conditions that need to be addressed, and ongoing challenges that could be better addressed. This preparatory work is presented in two documents completed in September 2015, the “Assessment Report of Ecological, Social, and Economic Conditions, Trends, and Sustainability” (USDA FS Carson NF 2015a), and “Carson National Forest’s Needs to Change Management Direction of Its Existing 1986 Forest Plan” (USDA FS Carson NF 2015b). The Carson identified current ecological and socioeconomic conditions and trends on the forest and the associated “needs for change” to be addressed by the revised plan. Those needs for change can be summarized into three revision topics: (1) terrestrial ecosystems and habitat, (2) watersheds and water, and (3) multiple uses and human influences.

Engagement of State and Local Governments, Other Federal Agencies, and Indian Tribes

Local tribes and communities depend on the economic, social, and ecological benefits provided by the Carson. The Carson supports jobs and economies, local traditional communities and uses, healthy wildlife populations, and clean air and water, among other benefits. Many of the issues and concerns facing the Carson, such as wildfire, impact local adjacent communities and require a cohesive management approach across the landscape. It is therefore essential that the representatives of tribes, counties, other Federal agencies, and local communities are actively involved in plan revision. In addition to the 16 government entities that participated as cooperating agencies, the Carson worked directly with local land grants, acequias, tribes, and non-governmental organizations throughout the planning process.

Three tribes with land adjacent to the Carson (Taos Pueblo, Picuris Pueblo, and Jicarilla Apache Nation) participated as cooperating agencies helping to develop the final plan alongside other government partners. They actively engaged to ensure tribal perspectives were included as part of the final revised plan.

Public Involvement

Public involvement in the planning process was initiated in June 2014 prior to developing the assessment. Prior to issuing the notice of intent to develop the draft plan and DEIS in October 2015, the Carson held over 30 public meetings in communities around the forest to hear from the public and start the process of building relationships with land grants, local community leaders, acequia associations, local and state governments, and tribes. Those meetings helped set the stage for the development of the draft forest plan DEIS. Following the notice of intent, the Carson received and responded to over 1,300 individual comments. The Carson continued to take comments on the notice of intent and other issues related to plan revision throughout the process of developing the draft plan and DEIS.

Throughout the development of the draft plan, draft wilderness evaluation, and draft wild and scenic river evaluation, the Carson posted documents as they were being developed on the plan revision web page and placed hard copies at each district office for the public to review and provide feedback. A preliminary draft plan was posted in July 2017, and an updated version that incorporated public feedback was posted in December 2017. The Carson received and considered over 600 comments on the preliminary draft plan prior to posting the second version. The forest received additional comments on the second version and discussed comments with those groups or individuals who requested a meeting, including the Northern New Mexico Stockmen's Association, The Wilderness Society, land grants, acequias, and tribes.

Significant Issues

Issues were identified from public comments, specifically scoping comments on the notice of intent, but also additional feedback received since then. Issues serve to highlight effects, both anticipated and unanticipated, that may occur from the proposed action or alternatives. Addressing the variety of issues identified during the analysis provides opportunities to reduce adverse effects and compare tradeoffs for the decisionmaker and public to understand. The Carson's planning team categorized the issues identified during scoping as either significant or nonsignificant. Significant issues were defined as those directly or indirectly caused by implementing the proposed action, that involved potentially significant effects, and that could be meaningfully and reasonably evaluated and addressed within the programmatic scope of the plan. Alternatives were developed around the significant issues that involved unresolved conflicts concerning alternative uses of available resources. The planning team identified the following significant issues during the public involvement process that drove subsequent development of alternatives:

- vegetation management, timber production, and fire and fuels management;
- wildlife habitat;
- access and recreation;
- recommended wilderness.

Alternatives

Five alternatives are analyzed in detail:

- alternative 1 (1986 Forest Plan);
- alternative 2 (proposed revised plan), which provides for restoration and diverse ecosystem services;
- alternative 3, which maximizes access and commodity utilization;
- alternative 4, which maximizes natural processes; and
- alternative 5, which maximizes wilderness protection.

The following alternatives were considered but dismissed from further evaluation (see chapter 2 for further discussion): an alternative that would restrict grazing; an alternative to conduct a grazing suitability analysis; an alternative to include all lands in the wilderness inventory as a recommended wilderness; an alternative that would manage all lands in the wilderness inventory as roadless areas; an alternative that would open or close roads; an alternative to designate the upper Ponil botanical area in Valle Vidal; an alternative that recommends 20 percent of ecosystems as wilderness areas; an alternative that would limit road density forestwide; an alternative that manages forest lands for carbon sequestration to offset greenhouse gas emissions; an alternative to incorporate the Southern Rockies Lynx management direction in the plan; and an alternative that specifies how desired conditions will be achieved.

Comparison of Alternatives

Table 1 is a summary of management under each alternative. Information in table 1 is focused on those activities, restrictions, or outputs that can be quantitatively or qualitatively distinguished across alternatives.

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Table 1. Primary differences between alternative content and outputs

Management Direction	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Mechanical treatment in ponderosa pine	No objectives, but occurring at 934 acres per year	2,200 to 5,000 acres per year	5,000 to 10,000 acres per year	No objectives, some wildland-urban interface treatment would occur at a rate of about 580 acres per year	2,200 to 5,000 acres per year
Mechanical treatment in dry mixed conifer	No objectives, but occurring at 434 acres per year	550 to 1,000 acres per year	1,500 to 3,000 acres per year	No objectives, some wildland-urban interface treatment would occur at a rate of about 350 acres per year	550 to 1,000 acres per year
Prescribed fire and naturally ignited wildfire in ponderosa pine.*	No objectives, but occurring at 1,234 acres per year	8,000 to 12,500 acres per year	8,000 to 12,500 acres per year	10,000 to 17,500 acres per year	8,000 to 12,500 acres per year
Prescribed fire and naturally ignited wildfire in dry mixed conifer.	No objectives, but occurring at 115 acres per year	2,000 to 4,000 acres per year	2,000 to 4,000 acres per year	2,500 to 5,000 acres per year	2,000 to 4,000 acres per year
Miles of roads obliterated or naturalized	Objective to obliterate 70 miles per year, but currently occurring at much lower rate	Obliterate or naturalize at least 20 miles per decade	No objective to obliterate or naturalize roads	Obliterate or naturalize at least 40 miles per decade, beginning in Wetland Jewel Management Area	Obliterate or naturalize at least 20 miles per decade
Miles of roads maintained	No objectives but currently occurring at a rate of approximately 500 miles per year	Maintain at least 500 miles annually	Maintain at least 650 miles annually	No objectives	Maintain at least 500 miles annually
Restore structure and function of riparian areas	No objectives but currently occurring a rate of approximately 200 acres per year	Restore at least 200 to 300 acres per year	Restore at least 200 to 300 acres per year	Restore at least 200 to 300 acres in the Wetland Jewel Management Area per year	Restore at least 200 to 300 acres per year
Provide sustainable recreation opportunities	No objectives, but existing infrastructure is currently not well maintained	Objectives to manage and improve recreation assets	Objectives to manage and improve recreation assets, plus additional objectives to update developed campgrounds from single to group sites and create a trail system for mountain bikes	Objectives to manage and improve recreation assets	Objectives to manage and improve recreation assets
Existing wilderness	110,662 acres	110,662 acres	110,662 acres	110,662 acres	110,662 acres

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Management Direction	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Recommend wilderness	0 acres	9,189 acres	0 acres	45,473 acres	67,996 acres
Eligible wild and scenic rivers	50 stream segments would be eligible	50 stream segments would be eligible	50 stream segments would be eligible	50 stream segments would be eligible	50 stream segments would be eligible
Designated wild & scenic rivers (managed by the BLM)	5 miles of Rio Grande River; 3.5 miles of Red River.	5 miles of Rio Grande River; 3.5 miles of Red River.	5 miles of Rio Grande River; 3.5 miles of Red River.	5 miles of Rio Grande River; 3.5 miles of Red River.	5 miles of Rio Grande River; 3.5 miles of Red River.
Valle Vidal Management Area	100,000 acres	100,000 acres	0 acres (managed under forestwide plan components)	100,000 acres	100,000 acres
Grassland Maintenance Management Area	72,734 acres	61,824 acres	61,824 acres	0 acres (managed under forestwide plan components)	61,824 acres
Off Highway Vehicle Management Area	0 acres (managed under forestwide plan components)	0 acres (managed under forestwide plan components)	2,978 acres	0 acres (managed under forestwide plan components)	0 acres (managed under forestwide plan components)
San Antonio Management Area	0 acres (managed under forestwide plan components)	117,035 acres	0 acres (managed under forestwide plan components)	148,000 acres	117,035 acres
Wetland Jewels Management Area	0 acres (managed under forestwide plan components)	0 acres (managed under forestwide plan components)	0 acres (managed under forestwide plan components)	79,630 acres across 10 areas	0 acres (managed under forestwide plan components)
Rio Grande Cutthroat Trout Management Area	0 acres (managed under forestwide plan components)	0 acres (managed under forestwide plan components)	0 acres (managed under forestwide plan components)	145,316 acres across 3 areas	0 acres (managed under forestwide plan components)
Suitable timber lands	382,355 acres	455,844 acres	458,724 acres	351,970 acres	440,550 acres
Projected timber sale quantity (PTSQ) MMCF/decade average	4.9	41	82.3	5.1	41
Projected wood sale quantity (PWSQ, MMCF/decade average)	10.7	48.9	94.8	7.7	48.9
Long-term sustained yield	10.7 MMCF per year	10.7 MMCF per year	10.7 MMCF per year	10.7 MMCF per year	10.7 MMCF per year
Annual total forest management jobs	1,508	1,731 to 1,738	1,976 to 1,980	1,478 to 1,483	1,728 to 1,733
Annual labor income (2016 dollars)	\$59,334,000	\$69,132,000 to \$69,274,000	\$80,059,000 to \$80,159,000	\$59,320,000 to \$59,420,000	\$69,082,000 to \$69,182,000

*Acres of lightning-caused wildfire counted toward this objective are only those that make progress toward or maintain desired conditions

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Chapter 1. Purpose of and Need for Action

Introduction

The Forest Service has prepared this environmental impact statement in compliance with the National Environmental Policy Act (NEPA) and other relevant Federal and State laws and regulations. This environmental impact statement discloses the indirect, and cumulative environmental and socio-economic impacts that would result from the proposed action and alternatives developed for the programmatic management of approximately 1.5 million acres administered by the Carson National Forest (also referred to as “the Carson”). Because the land management plan does not authorize or mandate any site-specific projects or activities (including ground-disturbing actions), there can be no direct effects. Impacts are based on predicted implementing activities and are meant to compare alternatives on a programmatic level, rather than provide exact measurements of effects.

This environmental impact statement analyzes five alternatives for revising the Carson National Forest 1986 Forest Plan, also referred to as the 1986 Forest Plan. Alternative 1 is the no-action alternative, which continues management under the 1986 Forest Plan, as amended. Alternative 2 is the proposed land management plan and is reflected in the accompanying Draft Land Management Plan for the Carson National Forest. It provides for restoration and diverse ecosystem services. Alternative 3 maximizes access and commodity utilization. Alternative 4 maximizes natural processes. Alternative 5 maximizes recommended wilderness. The selected alternative will replace the 1986 Forest Plan, as amended, which currently guides natural resource management activities on the Carson.

Additional documentation may be found in the project planning record located at the Carson National Forest Supervisor’s Office. Key analysis documents can be found online at:

www.fs.usda.gov/goto/carsonforestplan

Location

The Carson National Forest stretches across northern New Mexico, and includes 1,486,372 acres within the San Juan, Rio Grande, and Canadian River drainages. The Carson is divided into six ranger districts: Camino Real, Canjilon, El Rito, Jicarilla, Tres Piedras, and Questa. East of the Rio Grande Gorge, Questa and Camino Real Ranger Districts span the Sangre de Cristo Mountains (referred to as the “east side”). West of the Rio Grande, Tres Piedras, El Rito, and Canjilon ranger districts cover the slopes of the Tusas Mountains (referred to as the “west side”). To the far west, the Jicarilla Ranger District sits on the eastern edge of the San Juan Basin, with rugged buttes, steep canyons, and prominent mesas. The forest’s high elevations fill two major rivers, the Rio Grande and Rio Chama, and are vital water sources for both small local communities and larger urban areas downstream. The Carson shares boundaries with the Rio Grande National Forest in Colorado, Santa Fe National Forest, Taos Pueblo, Jicarilla Apache Nation, Southern Ute Tribe, Picuris Pueblo, U.S. Department of Interior (USDO I), Bureau of Land Management (BLM), the towns of Red River, Questa, Taos, Taos Ski Valley, Peñasco, Tres Piedras, El Rito, Canjilon, many other small communities, and private lands.

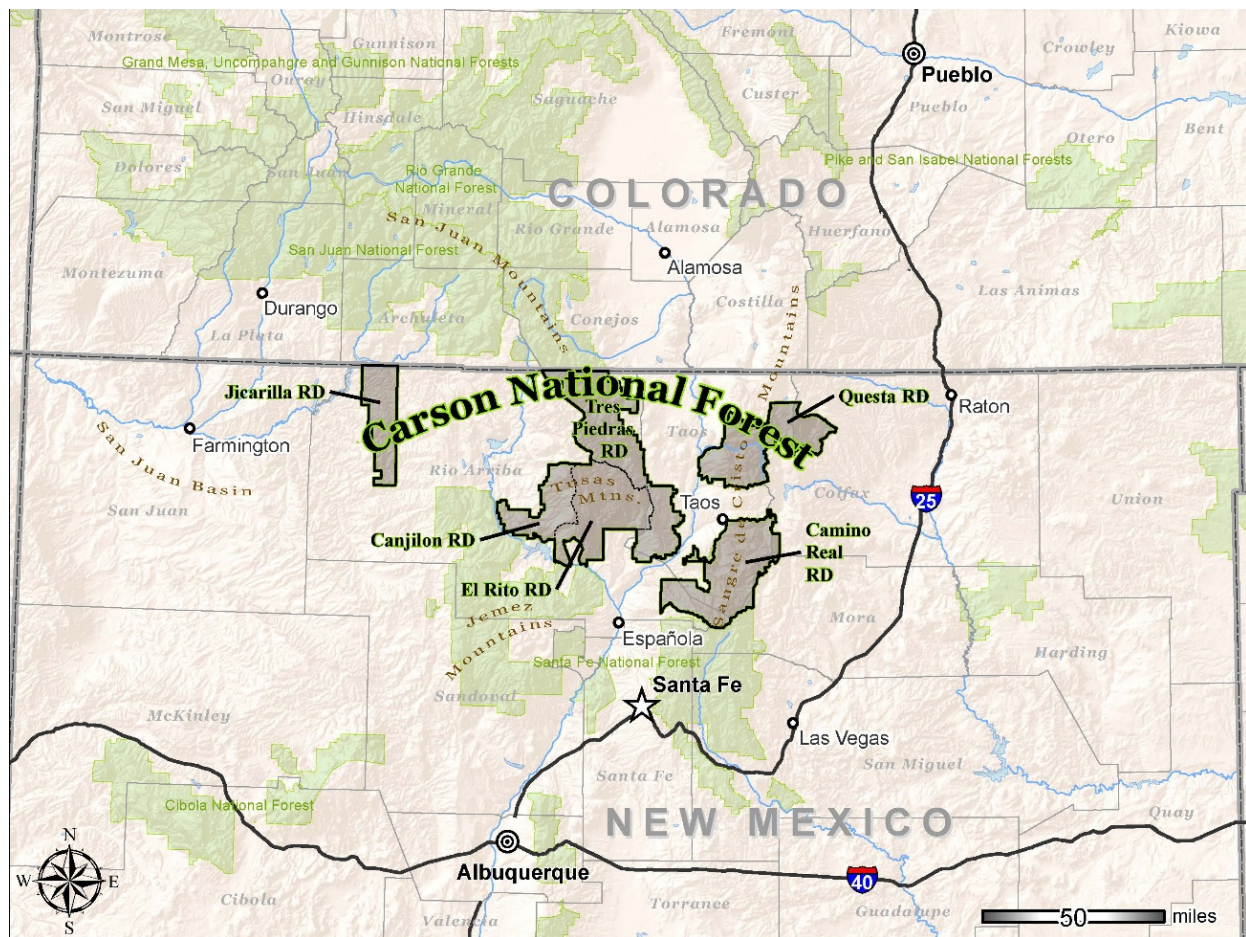


Figure 1. Carson National Forest and vicinity

Purpose and Needs for Change

The 1986 Carson National Forest Land Management Plan, as amended, is currently the primary document guiding the Carson National Forest in meeting the mission of the Forest Service. It guides forest managers' decision-making with respect to natural resources (e.g., soil, water, vegetation, and ecosystems) and human uses (e.g., recreation, thinning, livestock grazing, firewood gathering, special use permits, and search for solitude). The National Forest Management Act of 1976 directs every national forest to revise its plan:

- every 10 to 15 years;
- when conditions or demands in the area covered by the plan have changed significantly;
- when changes in agency policies, goals, or objectives would have a significant effect on forest-level programs; and
- when monitoring and evaluation indicate that a revision is necessary.

Since the 1986 Forest Plan was completed, there have been changes to ecological, social, and economic conditions in the area, as well as changes in resource demands, availability of new scientific information, and dissemination of new policy, including the 2012 Planning Rule. A complete revision of the plan is needed to: (1) meet the legal requirements of National Forest Management Act and the provisions of the

2012 Planning Rule, (2) guide natural resource management activities on the forest for the next 10 to 15 years, and (3) address needed changes in management direction.

In preparation for plan revision, Carson identified guidance in the 1986 Forest Plan that is working, new conditions that need to be addressed, and ongoing challenges that could be better addressed. This preparatory work is documented in two documents completed in September 2015, the “Assessment Report of Ecological, Social, and Economic Conditions, Trends, and Sustainability” (USDA FS Carson NF 2015a), and “Carson National Forest’s Needs to Change Management Direction of Its Existing 1986 Forest Plan” (USDA FS Carson NF 2015b). The Carson identified current ecological and socioeconomic conditions and trends on the forest and the associated “needs for change” to be addressed by the revised plan. Those needs for change can be summarized into three revision topics, described below: (1) terrestrial ecosystems and habitat, (2) watersheds and water, and (3) multiple uses and human influences.

Revision Topic 1: Terrestrial Ecosystems and Habitat

Ecological conditions have changed since the plan was issued in 1986, including recognition that vegetation conditions (i.e., structure, composition, connectivity, and function) are divergent from reference conditions; forest conditions indicate a substantial departure from natural fire regime; and plant and animal species need further consideration in the planning process. In addition, emerging issues, such as nonnative invasive plants and climate change, are not addressed by the 1986 Forest Plan. Following are needs to change the Carson’s 1986 Forest Plan associated with ecosystem health:

1. Develop desired conditions regarding forest, woodland, and shrubland structure, composition, connectivity, and function, as well as objectives, standards, and guidelines, to promote restoration and achievement of desired conditions; support resiliency and sustainability; and minimize risks to ecosystem integrity.
2. Provide plan direction to promote restoration and maintenance of grass productivity, particularly native bunchgrass species, and limit woody species encroachment and invasive plant establishment, both in grasslands and non-grasslands.
3. Update plan direction to enhance aspen health and resilience through managing regeneration (i.e., the use of wildland fire or other disturbances) and existing aspen stands.
4. Add plan direction to support integrated pest (invasive plant and animal) management.
5. Update plan direction to allow for an integrated resource approach to prescribed fire activity, as well as flexibility for restoration and maintenance of ecosystems.
6. Update plan direction to guide wildland fire use to achieve resource objectives (management of wildfire and prescribed fire) in fire adapted ecosystems, while addressing public safety and health concerns, especially in the wildland-urban interface.
7. Update plan direction to promote recovery and conservation of federally recognized species, maintenance of viable populations of the species of conservation concern, and maintenance of common and abundant species within the plan area.
8. Provide plan direction to address sustainability of habitat(s) for plant and animal species important to American Indian tribes and other traditional communities.
9. Incorporate plan direction to manage toward terrestrial, riparian, and aquatic habitat connectivity for species movement across the landscape.
10. Update plan direction to enhance wildlife habitat for species that need diverse forest habitats (i.e., interior, edge, young, and old forest), by using an assortment of management approaches, including timber harvest, thinning, prescribed burning, and other vegetation management methods.

11. Update plan direction to promote the maintenance and restoration of soil condition and function (i.e., soil hydrology, soil stability, nutrient cycling), particularly in lower elevation systems. Plan management approaches should focus on reducing the amount of exposed soil by restoring and maintaining sufficient vegetative cover, including downed woody material.
12. Incorporate plan direction that identifies adaptive management strategies and ecological desired conditions that are resilient to change.

Revision Topic 2: Watersheds and Water

The Carson contains some of the most productive and important watersheds in New Mexico. The Carson's high plateaus and rugged mountains are major sources of snowpack and stream runoff, contributing over 40 percent of the waters that flow into the Rio Grande from northern New Mexico and southern Colorado (USDA FS Carson NF 2015a). Land-based cultures that exist today in northern New Mexico have relied for many generations on water that comes off of Carson. In addition, emerging issues, such as decline of riparian vegetation and climate change, are not addressed by the 1986 Forest Plan. Following are needs to change the Carson's 1986 Forest Plan associated with water and watershed condition:

1. Provide plan direction to promote watershed health and function and restore and maintain ecological integrity of vegetation communities.
2. Identify plan direction to guide the restoration of watersheds.
3. Add desired watershed conditions to maintain water quality and quantity, as well as enhance retention.
4. Incorporate plan direction to enhance water resources (e.g., groundwater, springs, wetlands, riparian areas, perennial waters) and their interconnections.
5. Provide plan direction to promote the protection, restoration, and maintenance of appropriate composition and amount of riparian vegetation.
6. Update plan direction to support the management of riparian areas around all lakes, perennial and intermittent streams, and wetlands.
7. Add plan direction to address the protection, restoration, and maintenance of wetland condition and function.
8. Update plan direction to sustain watersheds for multiple uses (e.g., wildlife habitat, livestock grazing, recreation use, and mining) and water supplies for downstream users.
9. Add plan direction to allow for improving aquatic passage in streams where it has been compromised. Plan direction should also promote the restoration and expansion of the range of native aquatic species and connectivity of fragmented populations.

Revision Topic 3: Multiple Uses and Human Influences

The Carson is predominately a community forest, with numerous small unincorporated communities within the forest's boundaries, as well as several adjacent small incorporated towns and villages. The Carson contributes resources and uses, which are important to federally recognized tribes and pueblos, land grant communities, acequias, traditional Hispanic communities, and many contemporary residents all with historic, cultural, and social connections to the forest. Most of these traditional communities and families continue to look to the Carson for economic opportunity and vitality. Visitors to the Carson come for some form of recreation, making tourism the single largest contributor to the local economy for surrounding communities. Many area residents have jobs or businesses that are directly or indirectly dependent on tourism. Issues, such as recognizing livestock grazing and fuelwood gathering as important

uses to be continued on the Carson and a sustainable recreation program that will be able to adapt to changes in demand, available resources, and opportunities, are not addressed in the 1986 Forest Plan. Following are needs to change the Carson's 1986 Forest Plan associated with multiple uses and human influences.

1. Recognize in the plan Carson's continued contribution to social and economic benefits desired by local communities, families, and visitors and the need to sustain these contributions. Update the plan to provide services and products that local and visiting forest users want and need.
2. Identify in the plan how important and integrated relationships with local communities and groups are to management of the Carson.
3. Update plan direction to recognize American Indian traditional cultural properties and sacred sites and places, and non-American Indian traditional cultural properties.
4. Provide plan direction to address management of historic and contemporary cultural and traditional uses, including both economic and non-economic uses for federally recognized tribes and for traditional communities not considered under tribal relations (i.e., rural historic communities).
5. Recognize in the plan legally mandated trust responsibilities to federally recognized tribes.
6. Update plan direction to better protect privacy for federally recognized tribes engaged in cultural and ceremonial activities.
7. Incorporate plan direction to support sustainable rangelands for livestock grazing.
8. Provide plan direction to incorporate adaptive management in the livestock grazing program to move toward ecosystem-based desired conditions.
9. Provide plan direction to promote the Carson's ability to remain relevant and responsive to changing recreation user demands, while also being economically feasible and adaptable.
10. Provide plan direction for management of commercial and noncommercial use of forest products.
11. Add plan direction for the Continental Divide National Scenic Trail.
12. Provide plan direction to address the decommissioning of unneeded motorized roads and trails.
13. Update plan direction to identify and prioritize alternative methods and opportunities for repairing and maintaining existing infrastructure.
14. Update plan direction to authorize towers, facilities, and other infrastructure within electronic communication sites, while giving due consideration to the value and importance of these areas to federally recognized tribes.

Proposed Action

The Carson proposes to revise its 1986 Forest Plan to provide strategic, program-level guidance for management of resources and uses over the next 10 to 15 years. Proposed changes to the plan include updates to desired conditions, objectives, standards, guidelines, management areas, suitability, and monitoring requirements. The proposed action focuses on the three revision topics identified above and incorporates significant issues raised during the scoping process. The proposed action (revised plan) accompanies this document.

Plan Decisions

The proposed revised plan makes the following types of decisions:

- Desired conditions and objectives express an aspiration and form the basis for projects, activities, and uses that occur under the plan.
- Suitability determinations, standards, and guidelines set requirements to limit or guide forest uses or activities that are expected to occur under the plan.
- Management areas and designated areas identify desired conditions, uses, standards, and guidelines specific to those areas.

While the plan guides future management of the forest, it is strategic in nature and does not authorize projects or make site-specific project decisions. Those decisions are made following project-specific proposals and in conjunction with separate, site-specific National Environmental Policy Act (NEPA) analysis, with additional opportunities for public involvement.

Scope of the Analysis

Analysis in this FEIS is limited to the needs for change revision topics listed above and to significant issues (discussed below). Many issues raised during the scoping process are beyond the scope of this plan revision process and are not considered in the FEIS. For example, issues associated with site-specific activities that are addressed by project-level decisions are not addressed. The designation of specific roads, trails, and areas for motorized vehicle travel are not considered during plan revision because it is addressed in the separate environmental analyses for public motorized travel planning on the Carson (USDA FS Carson NF 2010a, 2010b, 2011, 2013). Some issues (e.g., increase law enforcement staffing), although important, are beyond the authority or control of the Carson and will not be addressed.

Decision Framework

The forest supervisor of the Carson will ultimately make the final decision on the selected alternative for the proposed revised plan. The forest supervisor will review the proposed action (alternative 2, proposed revised plan), other alternatives (1, 3, 4, and 5), and the environmental consequences of each, then decide which plan alternative, or combination of alternatives, best addresses the identified needs for change, issues raised during the scoping process, desired conditions, multiple use concept, diverse needs of people, sustainable management of the Carson, as well as the requirements of the National Forest Management Act (P.L. 94-588) and the Multiple-Use Sustained-Yield Act (P.L. 86-517).

Based on analysis in this environmental impact statement and subsequent public comments, the responsible official has identified a selected alternative in the record of decision that will be subject to an objection process guided by direction in 36 CFR Subpart B (219.50 to 219.62). Only those who have submitted “substantive formal comments” during the revision process will have standing to object (36 CFR 219.53, Eligibility to Object). A final record of decision and accompanying plan will set a course of action for managing the forest for the next 10 to 15 years. Project-level environmental analysis will still need to be completed for specific proposals to implement plan direction.

Public Involvement

From June 2014 through the issuance of the notice of intent to develop and draft plan and draft environmental impact statement (DEIS) in October 2015, the Carson held over 30 public meetings in communities all around the forest to hear from the public and start the process of building relationships with land grants, local community leaders, acequia associations, local and State governments, and tribes to help set the stage for the development of the draft plan DEIS.

The Carson initiated the development of its draft plan and DEIS on October 7, 2015, with the issuance of a notice of intent in the Federal Register. The notice of intent conveyed the Carson's intent to develop a revised plan (and alternatives) based on identified needs to change and analyze their respective effects on the environment. The Carson responded to over 1,300 individual comments. The Carson continued to take comments on the notice of intent and other issues related to plan revision throughout the entirety of the development of the draft plan and DEIS.

Public engagement throughout the process included direct engagement with local governments, as cooperating agencies, in the development of the plan; continual posting of planning documents as they were developed for public review and feedback; meetings with local land grants, acequias, tribes, and non-government groups; formal public meetings; and open houses for the public to learn, provide feedback, and ask questions.

From January 2016 through August 2016, the Carson conducted the wilderness inventory and evaluation process. Public meetings were held in 11 communities around the forest to help the public understand and effectively provide comments. In addition, the Carson held special meetings for land grants, stockman and permit holders, and local conservation groups. The Carson received over 700 comments from in-person meetings and the plan revision web site which allowed the public to review and comment on the wilderness process.

To gain a representative voice of these local communities and the greater public the Carson serves, the Carson worked with 16 local governments and three tribes as cooperating agencies directly involved in the development of the wilderness evaluation and draft plan. From December of 2015 through April 2018 the Carson met with its cooperating agencies 10 times to review and revise its draft documents. The cooperating agencies included four counties; six New Mexico Soil & Water Conservation Districts; the New Mexico Land Grant Council; the New Mexico Acequia Commission; the New Mexico departments of Forestry, Agriculture, Game & Fish, and Environment; and three federally recognized tribes.

The Carson also held two meetings, one in December 2014 and one in May 2015, for local, county, and State elected officials to inform them of the plan development process and how we were going to work with their communities to develop a draft plan.

Throughout the development of the draft plan, draft wilderness evaluation, and draft wild and scenic river evaluation, the Carson posted documents as they were being developed on the plan revision web page and placed hard copies at each of their district offices for the public to review and provide feedback. A preliminary draft plan was posted in July 2017, and an updated version that incorporated public feedback was posted again in December 2017. The Carson received and considered over 600 comments on the preliminary draft plan prior to posting the second version. The Carson received additional comments on the second version and spent time meeting with groups or individuals who requested a meeting, which included the Northern New Mexico Stockman's Association, The Wilderness Society, land grants, acequias and tribes, to discuss their comments.

To ensure the Carson was appropriately meeting the concerns of the rural historic communities, community discussion meetings were held with land grants, acequia associations, tribes, and local governments. Several joint tribal meetings were held, but the Carson also met with concerned tribes individually to keep them informed and to better understand how the Carson impacts the tribes and gain input on how to address their concerns when developing the revised plan. The Carson will continue to engage and involve rural historic communities and the tribes throughout the planning process, to learn, consider, and respect their ecological, social, and cultural needs and concerns.

In August 2017, the Carson held four place-based meetings to discuss potential management areas in areas around the forest that were of special interest to local communities, land grants, tribes, recreation

users, and conservation groups. The meetings were a way for the Carson to hear collectively from these users but also for them to hear from each other how they value and use the forest.

The Carson held monthly open houses beginning in August 2016, to allow the public to speak with and ask questions of Carson personnel on the many documents being developed as part of the draft plan and draft EIS.

The draft plan and draft environmental impact statement were released to the public in June 2019, prior to the formal comment period to allow additional time for review. A notice of availability published in the Federal Register on August 9, 2019 initiated the formal 90-day comment period on the draft environmental impact statement and draft forest plan as required by Forest Service regulations at 36 CFR 219. The comment period closed on November 7, 2019. During the 90-day comment period, the Carson held or attended 14 meetings with Tribes and Pueblos, cooperating agencies, community groups, non-profit organizations, and the public to discuss multiple methods for delivering and drafting official comment responses and an overview of draft plan content and the associated draft environmental impact statement. Additionally, three tri-forest meetings were held collaboratively with the Santa Fe and Cibola NFs, with one for Tribes and Pueblos, one for government officials, and one for the general public.

Comments received during the official 90-day comment period following the release of the draft plan and draft environmental impact statement have been distilled into concern statements that may cover multiple similar comments. The final documents reflect changes based on issues raised by public comment as described in appendix A of the final environmental impact statement. Public outreach meeting notes and additional information can be found in the planning record or on the plan revision website: www.fs.usda.gov/goto/carsonforestplan. Comments received since the publication of the notice of intent are included in the project record. The final opportunity for public involvement in the NEPA review and plan revision process follows the release of this final plan and final environmental impact statement. Only those individuals and entities who have submitted substantive formal comments related to this plan revision during the opportunities provided for public comment will be eligible to file an objection during the objection period (36 CFR 219.53(a)). The objection period begins with the publication of a public notice in the newspaper of record of the release of the final plan, final environmental impact statement, and draft record of decision and lasts for 60 days.

Tribal Consultation

Three tribes with land adjacent to the Carson (Taos Pueblo, Picuris Pueblo, and Jicarilla Apache Nation) participated as cooperating agencies helping to develop the draft plan alongside other government partners. They actively engaged to ensure tribal perspectives were included as part of the draft revised plan.

The forest held a tribal roundtable session in April 2017, inviting 16 tribes who have expressed interest in the cultural, spiritual, and historical importance of the NFS lands. The roundtable sessions were developed to allow the tribal partners to talk with forest leadership about what they wanted from forest management, what things they thought worked well, and how we could go forward collectively as we develop and implement the new plan. The Carson also participated in two Regional tribal roundtables held by the Southwest Regional Forester. These discussions brought together all of the national forests in New Mexico to discuss, learn, and collaborate with tribes around plan revision.

To better hear from the tribes, the Carson participated with several tribes (Taos Pueblo, Ohkay Owingeh, Picuris Pueblo, Santa Clara Pueblo, and the Jicarilla Apache Nation) quarterly to discuss current issues and potential projects. These quarterly discussions also included updates and information sharing around the plan revision process. The Carson's tribal liaison regularly reached out to other tribes to ensure that their interests were included in the draft plan.

Issues

Issues serve to highlight effects, both anticipated and unanticipated, that may occur from the proposed action or alternatives. Addressing the variety of issues identified during the analysis provides opportunities to reduce adverse effects and compare tradeoffs for the decisionmaker and public to understand. Issues were identified from public comments, specifically scoping comments on the notice of intent, but also additional feedback received since then. The Carson's planning team categorized the issues identified during scoping as either significant or nonsignificant. Significant issues were defined as those directly or indirectly caused by implementing the proposed action, that involved potentially significant effects, and that could be meaningfully and reasonably evaluated and addressed within the programmatic scope of the plan. Alternatives were developed around the significant issues that involved unresolved conflicts concerning alternative uses of available resources. The planning team identified the following significant issues during the public involvement process that drove subsequent development of alternatives:

Vegetation management, and fire and fuels management

Some commenters would prefer an emphasis on the use of natural ecosystem processes to achieve desired vegetation conditions, which they indicated would provide greater benefits to wildlife and less emphasis on mechanical treatment methods and timber harvest. They would like to see fewer acres suitable for timber production. Others stated there is not enough emphasis on the use of mechanical methods and timber harvest to achieve desired conditions and expressed concern regarding the appropriate balance between the social, economic, and ecological aspects of the plan. Some also noted that this low level of treatments would not meet the forest fuel reduction needs for the purpose of reducing fire intensity in proximity to private lands. They would like to see more lands allocated to higher-intensity timber management and/or an increase in the acres suitable for timber production. Related to this issue is the desire by some to see an increase in the fuelwood sale quantity to provide what they feel would be a better balance between the social, economic, and ecological aspects of the plan.

Some issues are best resolved at finer scales where the site-specific details of a specific action and the resources it affects can be meaningfully evaluated and weighed, subject to the NEPA process. Conversely, some issues have already been considered through a broader programmatic NEPA process (e.g., the Southern Rockies Lynx Management Direction). In these cases, the issues are more focused on evaluating the effects unique to and commensurate with the decision being considered.

Wildlife and aquatic habitat

Some commenters stated that the proposed action does not include adequate protections for wildlife and aquatic habitat, but others stated that the protections are adequate and that more management flexibility is needed to move toward all desired conditions on the Carson, including those that support biodiversity. Some commended the Carson for addressing connectivity in the desired conditions but wanted greater consideration of habitat connectivity at multiple scales. Some wanted all wildlife plan components to be mandatory with measurable standards, whereas others wanted broad desired conditions or guidelines that would allow for site-specific application at the project level.

Access and recreation

Public comments expressed desire for a variety of recreation opportunities as well as better maintained facilities, new roads, and new trails. Some people stated that the proposed action is too limiting to motorized opportunities and promotes non-motorized opportunities; they felt the Carson should have more motorized opportunities. Other commenters stated that there should be additional closures on roads and trails to protect wildlife and increase the amount of non-motorized recreation; they felt the Carson should offer fewer motorized opportunities.

Deliver provisioning ecosystem services

The value of water was a common theme in the comments received from the assessment and through scoping and plan development. Impaired or functioning at-risk watersheds are commonly impacted by poor water quality, soil erosion, and runoff from roads or trails. However, comments diverged on desires to minimize roads and trails to mitigate this impairment. The proposed revised plan considers mitigating the most egregious impairments to water quality while maintaining access and recreation. Other comments expressed the important role of the forest in mitigating future climate change and the availability for timber and forest products to support economic and rural stability.

Support traditional and cultural ways of life

The lands within the Carson have a long history of human use dating back thousands of years. The value of maintaining forest uses for living descendants as a part of their culture, traditional way of life, and rural prosperity was a major theme in comments from scoping. The revised plan recognizes the importance of access for traditional uses such as collecting forest products (e.g., fuelwood, piñon nuts, and herbs), use of sacred sites, maintenance of acequias, and other traditional uses. Some commenters expressed the importance that access is motorized, which is especially important for the elderly, while others appreciated non-motorized access as it is less obtrusive and provides more privacy. Preference for motorized versus non-motorized access also can depend on the activity or its specific location.

Livestock grazing is one specific traditional use that had divergent public comments. Some commented on its importance not only traditionally but also for rural prosperity. The proposed revised plan aims to provide healthy forested and non-forested lands that would supply forage for both livestock and wildlife. Other members of the public commented that livestock grazing has negative consequences, is unsustainable, and want to see it reduced.

Recommended wilderness

Some people stated the proposed action includes areas as recommended wilderness that do not meet the definition of the Wilderness Act and thus should not be recommended as wilderness, and others felt the proposed action did not include enough areas as recommended wilderness. Some people did not want to see any additional recommended wilderness areas.

Chapter 2. Alternatives

Introduction

This chapter describes the proposed action and other alternatives that satisfy the purpose of and need for revising the land management plan, addresses issues raised during scoping, and briefly discusses alternatives eliminated from detailed analysis. It includes descriptions of each alternative considered (see appendix B for alternative maps). This section also presents alternatives in a comparison table format, defining the differences between each alternative and providing a clear basis for choice among options by the decisionmaker and the public.

Development of Alternatives

Alternatives represent a range of possible management options from which to evaluate the comparative merits of the proposal. Each alternative emphasizes specific land and resource uses and de-emphasizes other uses in response to significant issues, primarily by changing management area allocations. All reasonable alternatives to the proposed action must meet the purpose and need for action and address one or more of the broad revision topics. For this plan, not all possible alternatives were considered in detail, as the list of options would have been prohibitively large. Instead, the responsible official identified those alternatives that meet both the purpose and need for action and that create a reasonable range of outputs, direction, costs, management requirements, and effects from which to choose.

All alternatives were developed to address:

- the purpose and need, as described in chapter 1, which includes the need for change;
- changes in socioeconomic or environmental conditions since the 1986 Forest Plan; and
- comments received during public scoping and feedback received on initial plan components, alternative themes, and management areas.

Environmental, social, and economic desires do not always coincide to provide a uniform path of action. Besides having separate and unique desired conditions, ways to achieve those desired conditions can also vary. Therefore, a range of alternatives was developed to encompass the diverse possibilities for management of this landscape and unresolved issues. When issues could not be incorporated into the proposed revised plan due to inherent conflicts (e.g., not enough wilderness areas versus too many wilderness areas) an alternative was developed. Some alternatives were analyzed in detail, while other alternatives were considered, but eliminated from further study.

Limited resources may constrain achievement of any plan alternative and are considered in the environmental consequences disclosed in this document. However, desired conditions must be achievable over time utilizing reasonable resources, and plan objectives were developed taking into consideration resource constraints and timeframes in which they would be achieved.

Climate change was also considered during the development of alternatives 2, 3, 4, and 5 and follows the strategy identified in “Southwestern Region Climate Change Trends and Forest Planning” (USDA FS 2010c). Given the difficulty of providing specific management guidance relative to climate change, the alternatives manage toward desired conditions regardless of current or changing conditions (such as climate change) with the intent to allow management of the forest to adapt as necessary and continue moving toward ecological and social desired conditions.

Alternatives Considered in Detail

Five alternatives are analyzed in detail: alternative 1 (1986 Forest Plan); alternative 2 (proposed revised plan), which provides for restoration and diverse ecosystem services; alternative 3, which maximizes access and commodity utilization; alternative 4, which maximizes natural processes; and alternative 5, which maximizes wilderness protection.

This chapter provides a general overview of each alternative and discusses how each alternative meets the needs for change topics and significant issues identified through collaboration with the public during the planning process. Although all alternatives provide a wide range of ecosystem services and multiple uses, some give slightly greater emphasis to selected resources based on the theme of the alternative and response to revision topics. Alternatives to the no-action alternative were developed based on the need for change (USDA FS Carson NF 2015b), information in the Forest's assessment (USDA FS Carson NF 2015a), implementation and monitoring of the current plan, collaborative meetings (2013 to 2014), and comments received during the public involvement period, interagency meetings, and meetings with tribal partners. The alternatives represent a range of possible management options. Each alternative emphasizes specific land and resource uses and de-emphasizes other uses in response to the revision topics. This is accomplished primarily by changing management area allocations on the Forest, resulting in tradeoffs among the alternatives. See appendix B for a detailed list of specific changes to plan components by alternative.

Elements Common to All Alternatives

All five alternatives have a number of features in common. In particular, they:

- comply with applicable laws, regulations, and policies;
- conserve soil and water resources and do not allow significant or permanent impairment of the productivity of the land;
- provide protections for riparian areas;
- maintain air quality that meets or exceeds applicable Federal, State, and/or local standards or regulations;
- provide for and maintain diversity of plant and animal communities to meet overall multiple-use objectives;
- provide for species' viability across the planning area;
- include measures for preventing destruction or adverse modification of critical habitat for threatened and endangered species;
- protect heritage resources;
- recognize unique status of Native American tribes and their rights retained by treaty with the United States, including consultation requirements;
- provide sustained multiple uses, products, and services in an environmentally acceptable manner (including leasable and locatable minerals, timber, livestock forage, and recreation opportunities);
- include opportunity for developing partnerships and collaboration;
- retain existing designated areas (e.g., wilderness areas, wild and scenic rivers);
- include management areas that provide additional direction beyond forestwide plan components specific to individual parcels of lands within the forest that represent a management emphasis for that parcel of land; and

- use a common list of species of conservation concern. The species of conservation concern were selected based on regional guidance and recommendations from Federal and State agency specialists.

In addition, progress toward desired conditions and objectives and the effectiveness of standards and guidelines are evaluated by a monitoring plan that provides continual feedback and evaluation.

Elements Common to All Action Alternatives

Alternatives 2, 3, 4, and 5 also share a number of features. In particular, they all:

- emphasize vegetation treatments in frequent-fire forests (ponderosa pine and mixed conifer with frequent fire) that are highly departed from desired conditions including historic fire regimes;
- emphasize restoration treatments in riparian areas or that otherwise benefit water resources, including stream channel and habitat restoration, watershed restoration, and invasive species removal;
- recognize and provide the traditional uses important for the unique cultural and social fabric of rural historic communities and tribes;
- include restoration treatments in riparian areas with an emphasis of the treatments benefitting water resources, including treatments such as stream channel and habitat restoration, watershed restoration, and invasive species removal;
- emphasize sustainable recreation and include guidance on implementing a sustainable recreation program;
- use the scenery management system to define scenic integrity objectives across the forest; and
- provide management direction for recommended wilderness.

Alternative 1 – No Action (1986 Plan)

Alternative 1, the no-action alternative, reflects current management practices under the 1986 Forest Plan, as amended and implemented. It provides the basis for comparing alternatives to current management and current levels of output.

Alternative 1 emphasizes producing timber products; managing quality habitat for Mexican spotted owl and northern goshawk and its prey; providing recreation opportunities to meet demand; and range management. The current plan has no articulated desired conditions for wetlands, seeps and springs, or some riparian ecosystems. It does not recognize traditional communities or uses that occur on the Carson and does not reflect changes in economic, social, and ecological conditions, new policies and priorities, or new information based on monitoring and scientific research. Management is organized using the existing 21 management areas that cover the entire forest. Since this alternative reflects no change in current management, no additional wilderness is recommended. This alternative provides a baseline for estimating effects of the other alternatives.

Alternative 1 relationship to significant issues

Vegetation management and fire and fuels management

The 1986 Forest Plan (as amended) incorporates an ecologically based approach in many of the goals, standards, and objectives related to vegetation conditions and associated wildlife habitat, both forestwide and in relation to potential vegetation types. This includes the concept of managing for vegetation conditions that would be expected to occur under natural succession and disturbance regimes to reduce the risk of undesirable effects from disturbances and maintain a resilient forest. In contrast to the action alternatives, direction is mostly in the form of general descriptions, with no specific or quantitative desired conditions that would allow evaluation of progress toward their achievement. For example, the

desired species, forest structural characteristics, and objectives for treatment of acres to achieve plan objectives have not been quantified at the plan scale. The Carson's ability to use naturally ignited fire as a tool to manage vegetation outside wilderness is limited. Fuel reduction objectives to protect values on private lands are lacking.

In the 1986 Forest Plan, direction associated with timber production and outputs is largely focused on maximizing growth and yield, with a high proportion of regeneration harvest expected.

Wildlife and fish habitat

The ecological description and focus of many of the goals, standards, and objectives related to vegetation composition, structure, and function are directly linked to providing or protecting habitat for wildlife species associated with these forest communities, particularly old-growth-associated species. This direction contributes to maintaining and improving habitat conditions for wildlife over time. However, there are no desired conditions or direction for certain vegetation communities that contribute to biodiversity and that are important to species dependent on those habitats (e.g., burned forest, deciduous forest, and non-forested types of vegetation). Little direction related to habitat connectivity is provided.

The 1986 Forest Plan (as amended) has forestwide goals, objectives, standards, and/or guidelines for species listed as threatened, endangered, or sensitive; management indicator species (e.g., big game species, species associated with old-growth forests); and species associated with dead and defective tree habitat. Some management areas also have a focus and direction to manage and protect specific wildlife habitat values, such as 1996 amendments for Mexican spotted and north goshawk and guidelines for (elk and deer winter range).

Access and recreation

Alternative A would continue to provide both motorized and non-motorized recreational opportunities as well as opportunities for mechanized transport (e.g., mountain bikes) and motorized over-snow vehicle use. Attention is given to closing roads as a means of protecting resources. The plan allows for flexible levels of recreation site maintenance, and there would not be limits on future development of overnight developed recreation sites other than those resulting from budget limitations or other plan direction.

Deliver provisioning ecosystem services

The 1986 Forest Plan includes plan direction to improve watershed health. Most of this direction focuses on the road system as roads can have substantial impacts to water and watershed health. The effects of activities on soil and water resources is minimized using best management practices. There is direction to improve watersheds in unsatisfactory condition, and maintain those that are satisfactory. Seventy miles of roads are to be obliterated each year. There is an emphasis on following the lead of the public as expressed through their demands for forest products and activities while the cornerstone of the Carson plan is maintaining options for the future.

Support traditional and cultural ways of life

The mission in the 1986 Forest Plan includes contributing to the quality of people's lives by providing special attention to small rural communities with dependence on forest resources and programs and traditional multi-cultural uses, but does not describe those communities or uses. The existing plan does not include any standards or guidelines that address traditional and cultural uses. The current plan aims to maintain the current level of livestock grazing. However, with the absence of specific objectives for improving vegetation, including forage, this can be difficult. Also, the absence of objectives for range infrastructure maintenance and improvements can impact both grazing numbers and ecological sustainability.

Recommended wilderness

The 1986 Forest Plan did not recommend any areas for wilderness designation.

Alternative 2 – Restoration to Provide Diverse Ecosystem Services (Original Proposed Land Management Plan)

Alternative 2 is the draft land management plan (USDA FS Carson NF 2019a) and was developed iteratively to respond to key issues identified with the interdisciplinary team and the public to address needs for change and issues. This alternative provides for restoration and diverse ecosystem services, or benefits that society obtains from the ecosystem. Alternative 2 addresses the need to better recognize and enhance the Carson’s role in contributing to local economies, including service-based sectors such as recreation and tourism, timber and forest products, livestock grazing, and other multiple-use related activities and products. It addresses the need for restoration of fire regimes, protection of communities, and the reintroduction of natural fire. Like all of the action alternatives, alternative 2 also includes plan direction that would allow for adaptive management to address ecological changes that have the potential to alter the availability of ecosystem services from the national forest.

Alternative 2 relationship to significant issues

Vegetation management and fire and fuels management

The proposed action uses a mix of mechanical treatments and wildland fire, both prescribed and naturally ignited, to move toward vegetative desired conditions. Naturally occurring fires should be allowed to perform their natural ecological role. Objectives are for a 10-year period and include acre ranges specified for mechanical treatment and fire (table 2).

Table 2. Alternative 2 acres of mechanical treatments and prescribed fire and wildfire

Vegetation Ecological Response Unit	Mechanical Treatment (acres)	Prescribed Fire and Naturally Ignited Wildfire (acres)
Mixed Conifer with Frequent Fire	5,500 to 10,000	20,000 to 40,000
Ponderosa Pine Forest	22,000 to 50,000	80,000 to 125,000

Water and watersheds

There are plan objectives to restore 200 to 300 acres of riparian areas, aligned with priority watersheds. Alternative 2 restores or enhances 100 to 150 miles of stream habitat and improves or maintains watershed function on a total of 300,000 to 500,000 acres.

Wildlife and fish habitat

Restoration treatments under this alternative would benefit wildlife by improving habitat. The San Antonio and Valle Vidal management areas recognize their importance as valuable wildlife habitat. There are objectives to restore or enhance at least 50,000 to 150,000 acres of terrestrial habitat and reconstruct or maintain 20 to 30 existing water developments for wildlife. Nonnative fish are reduced in 4 to 6 stream reaches with native fish populations. There are objectives to improve habitat connectivity for terrestrial and aquatic species and provide products and activities to educate the public about wildlife, fish, and plants.

Access and recreation

This alternative includes a mix of developed and dispersed recreation similar to what currently occurs on the forest. Maintenance of infrastructure, such as developed recreation sites and trails, would contribute

toward sustainable recreation by better meeting the needs of visitors and reducing ecological damage. Increasing recreation infrastructure would be unlikely under this alternative. It would decommission or eliminate unneeded forest roads and trails, while maintaining access for the public. There are objectives to obliterate or naturalize at least 20 miles of unneeded roads and maintain at least 100 miles of open roads and 100 to 300 miles of trails. There are objectives aimed at developing partnerships and maintaining relevancy. Areas receiving significant dispersed use, especially camping, would be managed to reduce adverse impacts through a guideline and an objective that address adverse impacts from dispersed camping sites.

Deliver provisioning ecosystem services

This alternative identifies the Jicarilla natural gas management area, the grasslands maintenance management area, and the developed winter and summer resort management area, which support natural gas production, forage availability, and developed recreation, respectively. Increased mechanical treatment and support of a restoration economy create opportunities for small businesses and would make fuelwood more available. Improved rangeland conditions would improve forage for livestock grazing and wildlife. Current motorized access for traditional and cultural uses would be maintained.

Support traditional and cultural ways of life

This alternative also puts a greater emphasis on traditional communities and uses, recognizing the importance of forest management's contribution to cultural, social, and economic needs. There are sections of the plan that define northern New Mexico traditional communities and uses and desired conditions and guidelines that recognize and value their importance. Availability of traditionally used products is protected. Current motorized access for traditional and cultural uses would be maintained.

Recommended wilderness

Recommended wilderness areas (9,189 acres) were selected where they would not limit ecosystem restoration and opportunities for traditional and cultural uses and would not impact the management of a watershed for downstream communities.

Alternative 3 – Maximize Access and Commodity Utilization

Alternative 3 responds to requests for more motorized recreation opportunities, enhanced mountain bike trails, and increased opportunities for fuelwood and timber production to support local economic development. This alternative also responds to public comments from those who do not want any additional wilderness on the Carson.

Alternative 3 relationship to significant issues

Vegetation management and fire and fuels management

Alternative 3 increases the rate of mechanical treatment to move toward vegetative desired conditions and produce more forest products, particularly commercial timber. While naturally occurring, fires are generally encouraged to perform their natural ecological role, they are restricted where they would interfere with human uses such as timber production or recreation. Objectives are for a 10-year period and include acre ranges specified for mechanical treatment and fire (see table 3).

Table 3. Alternative 3 acres of mechanical treatments and prescribed fire and wildfire

Vegetation Ecological Response Unit	Mechanical Treatment (acres)	Prescribed Fire and Naturally Ignited Wildfire (acres)
Mixed Conifer with Frequent Fire	15,000 to 30,000	20,000 to 40,000
Ponderosa Pine	50,000 to 100,000	80,000 to 125,000

Water and watersheds

The plan objectives for riparian, stream, and watershed treatment are the same as alternative 2.

Wildlife and fish habitat

The Valle Vidal and San Antonio Management Areas, which provide wildlife habitat, are removed. Habitat in those areas would instead be managed using forestwide plan components. Other plan components for wildlife habitat and connectivity are the same as alternative 2.

Access and recreation

Alternative 3 deemphasizes road decommissioning and looks for opportunities to convert non-system routes to off-highway vehicle and/or mountain bike trails. There is no objective to obliterate unneeded roads. There are objectives to maintain more miles of open roads (150 miles annually) and more miles of trails (200 to 400 miles annually). New road construction can occur without the requirement to decommission existing roads. Some developed recreation sites would be converted from single use to group use, and there is an objective to create a new mountain bike trail system. The off-highway vehicle management area would provide off-highway vehicle opportunities in rugged terrain on the Camino Real Ranger District. The Sipapu developed winter and summer resort management area would be expanded to provide opportunities for ski area expansion.

Deliver provisioning ecosystem services

Human uses are accommodated through maintaining roads instead of decommissioning them. More motorized access would provide more opportunities to collect fuelwood and other products. Increased levels of mechanical treatment significantly increase levels of commercial timber harvest and would create additional opportunities for small businesses and the local timber industry. The Jicarilla Natural Gas management area and Grasslands Maintenance management area are unchanged from alternative 2. The larger developed winter and summer resort management area would expand opportunities for the recreation industry.

Support traditional and cultural ways of life

Alternative 3 also emphasizes traditional communities and uses. While no new roads or motorized trails would be created by the plan, alternative 3 would allow the most potential for expanded motorized access for traditional and cultural uses. This could also impact cultural resources and sacred sites due to increased visitation.

Recommended wilderness

Alternative 3 does not recommend any areas for wilderness designation.

Alternative 4 – Maximize Natural Processes

Alternative 4 was developed to respond to requests to reduce the amount of mechanical treatment and motorized access. There is a heavier reliance on fire to move vegetation toward desired conditions. There is a focus on road decommissioning and obliteration of unneeded and temporary roads. Alternative 4 responds to requests to reduce timber removal and provide more primitive non-motorized opportunities on the Carson by recommending roughly 45,473 acres of wilderness.

Alternative 4 includes the following changes to management areas:

- Like alternative 2, Valle Vidal is identified as a management area, but with added restrictions, including no timber harvesting.
- Expands the San Antonio management area proposed in alternative 2 to include Cebolla Mesa on the east side of the Rio Grande gorge. This management area includes objectives for wildlife connectivity, standards for seasonal road closures, and restrictions on the management of vegetation.
- Adds the Wetland Jewels management area to add restrictions to and focus restoration in 10 significant wetland complexes. This management area includes objectives that prioritize work around wetlands and prohibits new roads, military ground operations, new utility infrastructure, and the establishment of new mineral rights.
- Adds the Rio Grande cutthroat trout management area to identify areas on the Carson where restoration of Rio Grande cutthroat trout habitat should be emphasized.

Alternative 4 relationship to significant issues

Vegetation management and fire and fuels management

Alternative 4 only uses mechanical treatment to treat hazardous fuels in the wildland-urban interface but includes no mechanical treatment objectives. Naturally occurring fires are encouraged to perform their natural ecological role and are the primary tool for forest restoration. Objectives are for a 10-year period and include acre ranges specified for mechanical treatment and fire (table 4).

Table 4. Alternative 4 acres of prescribed fire and wildfire

Vegetation Ecological Response Unit	Mechanical Treatment (acres)	Prescribed Fire and Naturally Ignited Wildfire (acres)
Mixed Conifer with Frequent Fire	not applicable	25,000 to 50,000
Ponderosa Pine	not applicable	50,000 to 100,000

Water and watersheds

Plan objectives for watershed treatment are the same as alternative 2. The objective to restore riparian areas must be accomplished in the Wetland Jewels Management Area.

Wildlife and fish habitat

Alternative 4 includes the Rio Grande Cutthroat Trout Management Area, which focuses the objective to treat nonnative fish in 4 to 6 stream reaches specifically in certain watersheds. The Wetland Jewels Management Area focuses on invertebrate, fish, waterfowl, and water bird habitat. There are additional restrictions on human use and objectives to remove unneeded structures or otherwise improve connectivity in the Valle Vidal and San Antonio Management Areas to improve wildlife habitat. The San Antonio Management Area is expanded to include areas on the Questa Ranger District, east of the Rio Grande.

Access and recreation

Though it does not close any roads, alternative 4 decreases opportunities for motorized access overall, both winter over-snow and other motor vehicle use. It encourages road decommissioning, obliteration, and naturalization of Forest Service system and non-system roads, as well as temporary roads. There is an objective to double the rate of obliteration and naturalization of unneeded roads to 40 miles over 10 years. The Valle Vidal, San Antonio, and Wetland Jewels Management Areas place some limits on motorized trails, and new permanent roads. The San Antonio Management Area is completely closed, except for certain roads and one trail, during certain times of year to protect elk calving and/or winter range. There would still be opportunities to collect fuelwood and other products, but forest access would be limited in certain areas, during certain times of year, and to certain uses more than under any other alternative. This alternative would provide the most primitive and semiprimitive recreation opportunities.

Deliver provisioning ecosystem services

Alternative 4 does not include any grassland maintenance management areas. That would limit forage availability, mostly in the southern portion of the westside districts, for livestock grazing and wildlife. There would be much less commercial timber production, but opportunities to collect other forest products would still exist, though the extent of those opportunities may be more limited due to limitations on future road creation and management area restrictions. There is a focus on providing certain ecosystem services in the Wetland Jewels (clean water, groundwater recharge, streamflow maintenance) and Rio Grande cutthroat (native fish) Management Areas.

Support traditional and cultural ways of life

Motorized access could be reduced under alternative 4 because of direction to reduce roads as discussed above. Road decommissioning in this alternative could reduce future motorized access for traditional and cultural uses. However, with decreased motorized access also comes an increase in non-motorized opportunities, which could increase privacy and confidentiality for cultural activities.

Less mechanical treatment could mean more uncharacteristic wildfire and less grassland restoration. Combined with the loss of forage due to the removal of grassland maintenance management areas there could be less opportunity for grazing under this alternative. Opportunities to collect forest products would exist, though the extent of those opportunities may be more limited due to limitations on future road creation and management area restrictions. Access limitations could result in more collection pressure on some products such as fuelwood that rely on motorized access.

Recommended wilderness

Recommended wilderness areas (45,473 acres) were selected where wilderness protection would limit commercial timber harvest and/or motorized use. They include those areas with wilderness characteristics that are not part of an inventoried roadless area and therefore timber harvest is not already prohibited, or are part of an inventoried roadless area where motorized use currently occurs.

Alternative 5 – Maximize Wilderness Protection

Alternative 5 was developed to respond to requests that all of the areas on the Carson evaluated as having wilderness characteristics be recommended as wilderness. Since not all of the evaluated areas fit into the other alternative themes, this alternative responds to the request that at least one alternative analyze 100 percent of areas that have wilderness characteristics.

Alternative 5 is the same as alternative 2, except for the following sections:

- Emphasizes wilderness opportunities of solitude, apparent naturalness, and non-motorized, non-mechanized recreation in a primitive setting.

- Includes all of the forestwide plan components, designated areas, and management areas identified in alternative 2, but recommends as wilderness all 13 areas (67,996 acres) identified as having wilderness characteristics.

Alternative 5 relationship to significant issues

Vegetation management and fire and fuels management

All objectives are the same as alternative 2. There would be some areas recommended for wilderness where fire and fuels management that would otherwise occur would not.

Water and watersheds

The plan objectives for riparian, stream, and watershed treatment are the same as alternative 2.

Wildlife and fish habitat

Recommended wilderness would prevent habitat management in some areas but could also reduce wildlife disturbance.

Access and recreation

No roads or motorized trails would be closed, but snowmobiling would be prohibited in several popular areas. There would be more non-motorized recreational opportunities than under alternative 2, but not as much primitive recreation as alternative 4.

Deliver provisioning ecosystem services

Provisioning ecosystem services would be similar to alternative 2.

Support traditional and cultural ways of life

Support for traditional and cultural ways of life would be similar to alternative 2.

Recommended wilderness

Recommends all areas identified as having wilderness characteristics (67,996 acres) as wilderness.

Alternatives Considered but Eliminated from Detailed Study

The NEPA requires Federal agencies to rigorously explore and objectively evaluate all reasonable alternatives and to briefly discuss the reasons for eliminating any alternatives that were not developed in detail (40 CFR 1502.14). Public comments received up until the release of this FEIS include suggestions of alternative methods for achieving the purpose and need. Some of these alternatives may have been outside the scope of the plan revision process or already addressed by alternatives considered in detail. The Forest carefully considered suggestions and has modified the plan and alternatives where appropriate. The following alternatives were considered but dismissed from further evaluation in this EIS for the reasons summarized below.

Alternative that would restrict grazing

Several comments were received to reduce or restrict grazing in riparian areas and high value water sources such as wetlands, in Alpine Tundra vegetation areas, and in riparian areas with threatened and endangered species that are dependent on these areas for habitat. A no-grazing alternative would not meet legal direction that forests will be managed using multiple use and sustained yield principles, as per the

National Forest Management Act and Multiple Use-Sustained Yield Act. Also, it would not allow the attainment of the desired condition for livestock grazing to contribute to the long-term socioeconomic diversity, stability, and cultural identity of local communities. Therefore, a no-grazing alternative is inconsistent with existing laws, Forest Service policy and direction, as well as the Forest Plan's desired conditions.

Under all alternatives, the rangelands management and livestock grazing program has multiple mechanisms to evaluate, review, and adapt management as needed to effectively protect resources and respond to changing conditions. Stocking decisions regarding the amount of livestock grazing authorized for each grazing allotment are considered as part of project-level analysis (NEPA) and beyond the scope of this programmatic analysis for the draft plan. Project-level analysis would cover changes to authorized grazing through term grazing permits (subject to forestwide standards and guidelines); allotment management plans; and annual operating instructions. In addition, the alternatives include a range of options of how to deal with vacant and understocked allotments that could increase or decrease grazing numbers. Based on this, it was concluded that a restricted grazing alternative was not necessary.

Alternative to conduct a grazing suitability analysis

A comment was received requesting that the Carson do a grazing suitability analysis as part of the draft plan. This was considered as an alternative but not analyzed in detail. The 2012 Planning Rule does not require that a suitability analysis be performed for grazing. The effects from grazing in each range allotment are evaluated and adjusted (1) throughout the season when each pasture rotation is being determined; (2) in detail at the beginning of the season when the annual operating instructions are determined; and (3) comprehensively on 10- to 15-year intervals, or more frequently when needed, as grazing is periodically re-authorized through the NEPA process. This allows for any needed adjustments to be made on a site-specific basis to maintain and move toward desired conditions for watersheds, wildlife habitat, and other resources.

Alternative to include all lands in the wilderness inventory as a recommended wilderness

The Carson considered but did not include an alternative based on the comment "one alternative should include the majority of the roughly 660,000 acres of inventoried areas." There is no requirement in the 2012 Planning Rule for all lands included in the inventory and subsequent evaluation to be carried forward in an alternative (FSH 1909.12, chapter 70.73). The planning rule requires that the responsible official shall identify which specific areas or portions thereof, from the evaluation to carry forward as recommended wilderness in one or more alternatives to be analyzed for effects. Additionally, not all lands in the wilderness inventory have wilderness characteristics meaning they can be excluded from further evaluation under the 2012 Planning Rule.

After completion of the inventory and the evaluation to determine what areas have wilderness characteristics, the responsible official selected only those areas that had wilderness characteristics to be considered for analysis. These areas were then considered for how they best met the intent of each alternative.

Alternative that would manage all lands in the wilderness inventory as roadless areas

Not allowing road construction in all areas from the wilderness inventory while continuing to allow them in non-inventory areas was not analyzed in detail. Most evaluation of the necessity of new roads would be made at a project level under all alternatives. The wilderness inventory was a filter applied as part of the wilderness recommendation process and not designed to evaluate the appropriateness of any other management action, including roads. The need and appropriate location of new roads is better judged

against the suite of desired conditions defined by the complete plan rather than the limited criteria used to identify wilderness inventory areas.

Alternative that would open or close roads

The scope of the Carson plan revision will not revisit the recent travel management decisions conducted in accordance with the Travel Management Rule. Site-specific decisions were made on all six districts that closed the forest to cross-country travel and designated an open road system based on multiple factors including public input. The transportation and forest access section of the plan incorporates these decisions through a transportation standard that prohibits motor use off the designated road system that states “motor vehicle use off the designated system of roads, trails, and areas identified on the Carson’s most up-to-date motor vehicle use map is prohibited, except as authorized by law, permits, or orders, to protect public safety and ecological resources.” Any future transportation system changes would be covered under a separate NEPA analysis.

Alternative to identify 1,000-foot-wide utility corridor management areas

An alternative to make new and existing energy utility corridors 1,000-feet wide was considered but not analyzed in detail. The plan has language that all utility infrastructure is the minimum required to meet Forest Service needs and the interest of the public; does not cause environmental disturbance; and is designed and located to minimize impacts to wildlife, scenery, and wildfire risk. To meet the requirements of this plan language, the Carson will develop utility corridors that meet minimum legal requirements while minimizing other impacts. Authorizations of standardized and very large utility corridors are unlikely to meet these requirements for a large portion of the Carson. Additionally, project- and site-specific needs for utility corridor widths are analyzed and determined as part of the permitting process.

Alternative that recommends 20 percent of ecosystems as wilderness areas

A comment was received to include 20 percent of all ecosystems on the Carson that are “underrepresented” (less than 20 percent) in all wilderness throughout the United States as recommended wilderness to “adequately protect ecosystem integrity and diversity as required by the 2012 Planning Rule.” This was considered as an alternative but not analyzed in detail. Ecosystem integrity and diversity are protected by other plan components. Recommendation as wilderness is not clearly the best management tool for achieving this protection. The plan components for all vegetation in the plan are designed to protect ecosystem integrity and diversity as required by the 2012 Planning Rule.

Alternative to designate the Upper Ponil Botanical Area in Valle Vidal

A comment was made to designate an area within Valle Vidal as the Upper Ponil Botanical Area. This was considered as an alternative but not in detail. There is management direction for the bristlecone pine vegetation community, which is within this area. In addition, the Valle Vidal Management Area, the Ash Mountain recommended wilderness, and the Little Costilla Peak and Clayton Pass proposed research natural areas provide resource protections that are more specific than forestwide plan components.

Alternative that would limit road density forestwide

An alternative was suggested that would “include motorized route density standards to conform to the best scientific recommendations, generally less than 1 mile per square mile.” This alternative was considered but not in detail because recent site-specific analysis and decisions have been made on the forest that identified the open road system during the travel management process. Under the travel management process, alternatives were developed and analyzed based on issues including the effects on wildlife, sedimentation, and erosion. Decisions were based on a collaborative process and scientifically based information and resulted in a current road density of about 1.1 miles per square mile. While it is

desirable to minimize new roads and decommission unneeded roads, managing toward a specific road density would be arbitrary and would not meet the purpose and need.

Alternative that manages forest lands for carbon sequestration to offset greenhouse gas emissions

An alternative was proposed to add plan language that would promote carbon sequestration on the Carson. This alternative was considered but not analyzed in detail. The plan manages for overall ecosystem function, which implies inherent levels of carbon sequestration and greenhouse gas emissions. Management to maximize carbon sequestration over other ecosystem services is not a goal of the plan. The Forest Service is required to design new facilities that reduce energy usage to reduce greenhouse gas emissions.

Alternative to incorporate the Southern Rockies lynx management direction in plan

Canada lynx are not typically found on the Carson, since the forest naturally lacks the physical and biological features necessary to sustain a population (USDI FWS 2014a, 2014b). Historically, the Carson did not support naturally resident lynx populations. In 1999, Canada lynx were reintroduced into southern Colorado, and on occasion an individual lynx may roam out of Colorado onto the Carson in New Mexico. As Canada lynx is not known to den or breed on the forest, lynx analysis units have not been established on the Carson, and the U.S. Fish and Wildlife Service (USFWS) has not recommended the Forest Service do so. Since this species is a federally listed species, the Endangered Species Act requires consultation with the USFWS during the NEPA process on any management activities that may affect lynx or its habitat. Since a revised plan will provide management direction in potential lynx habitat on the Carson, consultation with the USFWS will take place. A crosswalk was created to display the Southern Rockies Management Direction and the Carson's plan components that correspond to this direction (appendix H).

Alternative that specifies how desired conditions will be achieved

The intent of the plan is to develop a vision for the future of the resources managed by the Carson. The forest achieves this vision by developing and implementing projects and activities that will move toward desired conditions. The plan is flexible so that as best available science changes or is improved, new and different approaches can be developed and adopted to best reach desired conditions.

Comparison of Alternatives

This section provides a summary of management under each alternative. Information in table 5 focuses on those activities, restrictions, or outputs that can be quantitatively or qualitatively distinguished across alternatives.

Table 5. Primary differences between alternative content and outputs

Management Direction	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Mechanical treatment in ponderosa pine	No objectives, but occurring at 934 acres per year	2,200 to 5,000 acres per year	5,000 to 10,000 acres per year	No objectives, some wildland-urban interface treatment would occur at a rate of about 580 acres per year	2,200 to 5,000 acres per year
Mechanical treatment in dry mixed conifer	No objectives, but occurring at 434 acres per year	550 to 1,000 acres per year	1,500 to 3,000 acres per year	No objectives, some wildland-urban interface treatment would occur at a rate of about 350 acres per year	550 to 1,000 acres per year
Prescribed fire and naturally ignited wildfire in ponderosa pine *	No objectives, but occurring at 1,234 acres per year	8,000 to 12,500 acres per year	8,000 to 12,500 acres per year	10,000 to 17,500 acres per year	8,000 to 12,500 acres per year
Prescribed fire and naturally ignited wildfire in dry mixed conifer *	No objectives, but occurring at 115 acres per year	2,000 to 4,000 acres per year	2,000 to 4,000 acres per year	2,500 to 5,000 acres per year	2,000 to 4,000 acres per year
Miles of roads obliterated or naturalized	Objective to obliterate 70 miles per year, but currently occurring at much lower rate	Obliterate or naturalize at least 20 miles per decade	No objective to obliterate or naturalize roads	Obliterate or naturalize at least 40 miles per decade, beginning in the Wetland Jewel Management Area	Obliterate or naturalize at least 20 miles per decade
Miles of roads maintained	No objectives but currently occurring at a rate of approximately 500 miles per year	Maintain at least 500 miles annually	Maintain at least 650 miles annually	No objectives	Maintain at least 500 miles annually
Restore structure and function of riparian areas	No objectives but currently occurring a rate of approximately 200 acres per year	Restore at least 200 to 300 acres per year	Restore at least 200 to 300 acres per year	Restore at least 200 to 300 acres in the Wetland Jewel Management Area per year	Restore at least 200 to 300 acres per year

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Management Direction	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Provide sustainable recreation opportunities	No objectives, but existing infrastructure is currently not well maintained	Objectives to manage and improve recreation assets	Objectives to manage and improve recreation assets, plus additional objectives to update developed campgrounds from single to group sites and create a trail system for mountain bikes	Objectives to manage and improve recreation assets	Objectives to manage and improve recreation assets
Existing wilderness	110,662 acres	110,662 acres	110,662 acres	110,662 acres	110,662 acres
Recommend wilderness	0 acres	9,189 acres	0 acres	45,473 acres	67,996 acres
Eligible wild and scenic rivers	50 stream segments would be eligible	50 stream segments would be eligible	50 stream segments would be eligible	50 stream segments would be eligible	50 stream segments would be eligible
Designated wild and scenic rivers (managed by the BLM)	5 miles of Rio Grande River; 3.5 miles of Red River.	5 miles of Rio Grande River; 3.5 miles of Red River.	5 miles of Rio Grande River; 3.5 miles of Red River	5 miles of Rio Grande River; 3.5 miles of Red River	5 miles of Rio Grande River; 3.5 miles of Red River
Valle Vidal Management Area	100,000 acres	100,000 acres	0 acres (managed under forestwide plan components)	100,000 acres	100,000 acres
Grassland Maintenance Management Area	72,734 acres	61,824 acres	61,824 acres	0 acres (managed under forestwide plan components)	61,824 acres
Off Highway Vehicle Management Area	0 acres (managed under forestwide plan components)	0 acres (managed under forestwide plan components)	2,978 acres	0 acres (managed under forestwide plan components)	0 acres (managed under forestwide plan components)
San Antonio Management Area	0 acres (managed under forestwide plan components)	117,035 acres	0 acres (managed under forestwide plan components)	148,000 acres	117,035 acres
Wetland Jewels Management Area	0 acres (managed under forestwide plan components)	0 acres (managed under forestwide plan components)	0 acres (managed under forestwide plan components)	79,630 acres across 10 areas	0 acres (managed under forestwide plan components)
Rio Grande Cutthroat Trout Management Area	0 acres (managed under forestwide plan components)	0 acres (managed under forestwide plan components)	0 acres (managed under forestwide plan components)	145,316 acres across 3 areas	0 acres (managed under forestwide plan components)
Suitable timber lands	382,355 acres	455,844 acres	458,724 acres	351,970 acres	440,550 acres
Projected timber sale quantity (PTSQ) MMCF/decade average	4.9	41	82.3	5.1	41

Management Direction	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Projected wood sale quantity (PWSQ, MMCF/decade average)	10.7	48.9	94.8	7.7	48.9
Long-term sustained yield (LTSY)	10.7 MMCF per year	10.7 MMCF per year	10.7 MMCF per year	10.7 MMCF per year	10.7 MMCF per year
Annual total forest management jobs	1,508	1,731 to 1,738	1,976 to 1,980	1,478 to 1,483	1,728 to 1,733
Annual labor income (2016 dollars)	\$59,334,000	\$69,132,000 to \$69,274,000	\$80,059,000 to \$80,159,000	\$59,320,000 to \$59,420,000	\$69,082,000 to \$69,182,000

*Acres of lightning-caused wildfire counted toward this objective are only those that make progress toward or maintain desired conditions.

Ability of each Alternative to Achieve the Desired Conditions

Table 6 through table 14 are organized by management need and focus on the ability of each alternative to achieve the desired conditions that were developed to address the key issues that drove the need for change. These issues were identified from the assessment as those resource areas that were most at risk as a result of management direction identified in the 1986 Forest Plan. The key for using tables 6 through 14 follows:

- = very ineffective at achieving desired conditions
- = ineffective at achieving desired conditions
- O = neutral or maintains current conditions
- + = effective at achieving desired conditions
- ++ = very effective at achieving desired conditions

Table 6. Comparison of the alternatives by management need to reduce tree density in ponderosa pine and dry mixed conifer forests to move toward desired seral state conditions (open, uneven-aged) with mechanical treatment

Desired Conditions	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Vegetative structure within historic range of variation	--	+	++	-	+
Robust understory	-	++	++	+	++
High soil integrity and productivity (long term)	O	+	+	+	+
High soil integrity and productivity (short term)	O	+	-	+	+
Forest products provide a source of employment and income over the plan period	-	++	++	--	++
High scenic integrity (long term)	-	+	+	-	+
High scenic integrity (short term)	O	-	--	O	-

Table 7. Comparison of the alternatives by management need to restore historic fire regime in frequent fire forests through a combination of naturally ignited wildland fire and prescribed fire

Desired Conditions	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Frequent, low-severity fire plays its natural role	-	++	+	+	++
Uncharacteristic, high-severity fire is rare	--	++	+	-	+
Satisfactory soil hydrologic function	O	+	-	-	+
Satisfactory nutrient cycling	-	++	-	+	++
Minimize impacts from prescribed fire emissions (adverse health effects to sensitive persons)	O	-	-	-	-
High scenic integrity (long term)	--	+	+	+	+
High scenic integrity (short term)	O	-	--	--	-

Table 8. Comparison of the alternatives by management need to reduce the risk of uncharacteristic high-severity fire and protect communities

Desired Conditions	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Uncharacteristic, high-severity fire is rare	--	++	+	-	+
Protection of watershed/soil function	--	++	+	-	+
Protection of water quality	--	++	+	-	+
Protection of habitat	--	++	+	-	+
Wildland-urban interface fuel conditions facilitate effective fire management	O	+	+	O	+
Low threat to values at risk	-	+	+	-	+
Protection of recreation settings	-	+	+	--	+
Protection of heritage resources	+	+	+	+	+
Prevention of uncharacteristic, higher emission-producing fire (smoke)	--	+	+	-	+
Low fire suppression/rehabilitation cost	--	+	--	--	+

Table 9. Comparison of the alternatives by management need to protect and restore springs and wetlands and the need to define riparian management zones with additional protections for riparian resources

Resource	Desired Conditions	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Springs/ Wetlands	Satisfactory availability of riparian habitat	O	+	+	+	+
Springs/ Wetlands	Water quantity/quality sufficient to support ecosystem and human needs	+	++	+	+	++
Springs/ Wetlands	Prevent trampling of vegetation and soils	+	++	++	++	++
Riparian	Riparian areas are intact and functioning properly	O	++	++	++	++
Riparian	Management in riparian areas moves them toward desired conditions	+	++	++	++	++

Table 10. Comparison of the alternatives by management need to restore grassland by reducing encroaching conifers

Desired Conditions	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Grass, forb, and shrub diversity and cover	-	++	++	-	++
Grasslands present in historic extent	--	+	+	-	+
High quality habitat for grassland species	-	++	++	+	++
Satisfactory nutrient cycling	-	+	+	-	+

Table 11. Comparison of the alternatives by management need to adaptively manage for resilient ecosystems

Desired Conditions	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Reduces tree densities	-	+	++	-	+
Adapts management based on observed successes	-	++	+	+	+

Table 12. Comparison of the alternatives by management need to develop plan guidance for wildlife habitat needs

Desired Conditions	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Minimal risk of adverse impacts from uncharacteristic wildfire (wildland-urban interface)	-	++	+	+	+
Habitat for species w/high viability risk	-	+	+	+	+
Protection of rare and endemic species	-	+	+	+	+
Habitat provided for species of conservation concern	O	++	+	+	++
Habitat provided for migratory bird species	-	+	+	+	+
Habitat provided for listed species	+	++	++	++	++
Habitat connectivity	-	++	+	++	++

Table 13. Comparison of the alternatives by need to manage recreation to be relevant and responsive to user needs

Desired Conditions	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Activities important to traditional communities are available	+	++	++	+	+
A variety of high quality dispersed and developed rec opportunities exist	-	++	++	-	++
Opportunities are adaptable to changing uses and trends	-	+	+	+	+
Opportunities are sustainable and support local economic and cultural vitality	-	+	+	+	+
A system of motorized and non-motorized trails meet public need	-	+	++	-	+
Recreation opportunities exist relevant to the recreation opportunity spectrum	+	+	+	+	+

Table 14. Comparison of the alternatives by management need to contribute to opportunities for traditional and cultural uses

Desired Conditions	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Resources important to traditional use are available and sustainable	-	+	+	O	+
Access is available to places of traditional use	+	++	++	+	+
Access for work on acequias is available	+	+	+	+	+
Activities important to traditional communities are available	+	++	++	+	+
Forage for livestock grazing exists	-	++	++	-	++
Grazing contributes to cultural and economic needs	+	++	++	-	+
Forest products (including fuelwood) are available for traditional needs	+	++	++	-	++

Chapter 3. Affected Environment and Environmental Consequences

This chapter summarizes physical, biological, social, and economic environments of the planning area and effects to those environments of implementing each alternative. It also presents the scientific and analytical basis for the comparison of alternatives presented in chapter 2.

The land management plan provides a programmatic framework that guides site-specific actions but does not authorize, fund, or carry out any project or activity. Because the land management plan does not authorize or mandate any site-specific projects or activities (including ground-disturbing actions), there can be no direct effects. However, there may be implications, or long-term environmental consequences, of managing the forest under this programmatic framework. Those environmental consequences are described in this chapter. Consequences are based on predicted implementing activities and are meant to compare alternatives on a programmatic level, rather than provide exact measurements of effects.

Assumptions Common to All Resources

The following assumptions were made for this analysis:

- Land management plans do not have direct effects. They do not authorize or mandate any site-specific projects or activities, including ground-disturbing actions. However, there may be implications, or longer-term environmental consequences, of managing the forest under this programmatic framework.
- Plan decisions (desired conditions, objectives, standards, guidelines) and other plan direction (management areas and monitoring) would be followed when planning or implementing site-specific projects and activities.
- Law, policy, and regulations would be followed when planning or implementing site-specific projects and activities.
- Funding levels would be similar to the past 5 years.
- The planning timeframe for the effects analysis is 10 to 15 years; other timeframes may be specifically analyzed depending on the resource and potential consequences.
- Monitoring identified in the “Monitoring” chapter would occur and the land management plan would be amended, as needed, during the life of the plan.

Management Implications of Projected Future Climate

Climate scientists agree that the earth is undergoing a warming trend and human-caused elevations in atmospheric concentrations of carbon dioxide (CO₂) and other greenhouse gases are chief among the potential causes of global temperature increases. The concentrations of these greenhouse gases are projected to increase into the future, and climate shifts will intensify the risk of ecosystem change in terrestrial and aquatic systems, affecting ecosystem structure, function, and productivity and threatening ecosystem services (Gowda et al. 2018; USDA FS 2010b, 2014b). The uncertainty that accompanies a changing climate creates challenges for natural resource management and dependent communities (Gowda et al. 2018; J. L. Hand et al. 2011; Jantarasami et al. 2018). Broad scientific ecological knowledge is based on observations of natural process and interaction under past and current climatic conditions. Complex interactions will occur among species as they migrate and adapt in response to changing environmental conditions. Future management will benefit by being adaptive, innovative, and

flexible as species associations and environmental stressors without historical equivalent emerge (Millar et al. 2007).

Management that reduces stressors that are well understood will produce ecosystems with better baseline resiliency and more adaptive capacity to continue to function in the face of other, more uncertain stressors (Hanberry et al. 2015). Strategies for management that take climate uncertainty into consideration are integrated throughout the plan. Together they provide a framework for management that would:

- restore and maintain composition, structure, and function of ecosystems;
- move highly departed ecosystems toward desired conditions;
- reduce the threat of uncharacteristic wildfire while promoting natural fire as a process;
- promote interconnectedness of habitat to allow for species adaptation, including genetic and behavioral interactions; and
- maintain the quality, distribution, and abundance of habitats to support recovery and stabilization of federally listed and other species.

The implications of climate change for both society and natural resources are profound and complex, as are the challenges of integrating adaptation and mitigation responses. A successful approach will be based on thorough assessments and well-tailored policies, engaging a full range of stakeholders across the landscape in activities for adaptation, mitigation, and education (USDA FS 2010c). While the Carson is at lower risk of climate-related future change than some other national forests in the Southwestern Region, there are changes that are likely to occur and a high likelihood that communities around the forest will be negatively affected (Hand et al. 2018; USDA FS 2014a).

All action alternatives have incorporated climate change into the management of resources and have pinpointed desired conditions and objectives that increase the ecological resiliency of the Carson to predicted changes in climate. For example, the vegetation management practices outlined under all action alternatives are capable of reducing drought stress and the risk of uncharacteristic fire, both of which are consequences of changing temperature and precipitation regimes combined with uncharacteristically dense and fuel-laden forests. Management practices are also designed to allow for the flexibility to address changing conditions over time.

The Forest Service is currently engaged through multiple approaches in developing strategies and tools to address climate change. The National Roadmap for Responding to Climate Change outlines broad assessment, engagement, and management actions for National Forests to follow (USDA FS 2010b). The FS Climate Change Resource Center (USDA FS 2018a) is an online climate change information clearinghouse. It has information for land managers on basic climate science, topic pages on natural resource science and management related to climate change, video courses, case studies, and climate change tools. Additional strategies and tools will be needed in the future as patterns of change arise and scientific understanding develops.

Vegetation Communities and Fuels

A primary goal of plan direction related to the vegetation component is to provide for ecological integrity and sustainability, supporting a full range of native plant and animal species while providing for the social and economic needs of human communities. Healthy, resilient landscapes have a greater capacity to survive natural disturbances and large-scale threats to ecological sustainability, especially under changing and uncertain future environmental conditions, such as those driven by changing climate and increasing human use (FSM 2020). Fire has long played a role in shaping the vegetation of the Carson, and in turn vegetation is the fuel that carries fire. The integrity of much of the Carson is dependent on fire as a frequent disturbance since the structure and function of vegetation are closely intertwined with the

disruptive and regenerative process that fire initiates. Because of their close interdependence, vegetation, and fuels are examined together in this section.

Description of Affected Environment

General Vegetation and Fuels–Affected Environment

This section describes vegetation and vegetation as fuel for wildfire in general terms. Many management decisions have distinct impacts in different vegetation types, or are specific to areas that are dominated by a subset of the kinds of vegetation that occur across the Carson. Specific vegetation communities are described in the sections that follow.

There are thirteen major vegetation communities on the Carson whose distribution is shaped by elevation and topography (table 15). The landscape of the Carson is fairly evenly distributed among three broad classes of vegetation communities (vegetation systems): high-elevation forests (27 percent), frequent fire forests (31 percent), and woodlands (25 percent). Sagebrush shrublands are found at the lowest elevations (3.7 percent). Grasslands and riparian areas occur across the forest at a wide range of elevations and make up about 8 and 3.5 percent of the Carson, respectively. Alpine and tundra make up less than 1 percent of the Carson, and aspen occurs as a seral state (4.5 percent) or minor inclusion in the forested communities.

Table 15. Vegetation communities on the Carson by vegetation system

Vegetation System	Vegetation Community	Acres	Percent⁴
Alpine and Tundra	Alpine and Tundra	9,996	0.6
High-Elevation Forest	Bristlecone Pine	4,585	0.3
High-Elevation Forest	Spruce-Fir Forest	289,929	18.3
High-Elevation Forest	Mixed Conifer with Aspen	130,959	8.3
Aspen ¹	Aspen	71,551+	4.5+
Frequent Fire Forests	Mixed Conifer-Frequent Fire	182,847	11.5
Frequent Fire Forests	Ponderosa Pine Forest	312,900	19.7
Woodlands	Pinon-Juniper Woodland	178,196	11.2
Woodlands	Pinon-Juniper Sage	217,326	13.7
Shrublands	Sagebrush Shrubland	59,144	3.7
Grasslands ²	Montana Subalpine Grassland	125,351+	7.9+
Riparian	Wetland Riparian ³	36,366+	2.3+
Riparian	Forest and Shrub Riparian	19,948	1.3

1. Aspen acres include only those acres counted as a seral state in spruce-fir forest and mixed conifer with aspen vegetation communities. There are additional unquantified acres of aspen that occur as minor inclusions in the frequent fire forest communities.
2. Grassland acres include only those acres in the montane subalpine grassland vegetation community. There are additional unquantified grassland acres that occur in the herbaceous riparian community, or as minor inclusions in forests, woodlands, and shrublands.
3. The wetland riparian vegetation community acres include only those in the herbaceous riparian ecological response unit. There are additional unquantified acres of Wetland Riparian that occur as a minor inclusion in other communities.
4. Percentages do not add up to 100 percent since some communities overlap, and every acre on the Carson is not represented by one of these communities.

The vegetation analysis in this section is organized using three taxonomies. The most generalized tier describes vegetation systems that are broad conglomerates of similar plant habit and species associations. Generally, these groups follow elevational gradients, but are also influenced by similar characteristic disturbances and stressors and therefore the impacts of management are similar. Some vegetation systems

are composed of multiple vegetation communities. A vegetation community is an ecosystem type describing ranges of biophysical themes (e.g., fire history, site potential, dominant species, vegetation associations, soils, landscape features, climate, etc.) that prevail under the characteristic disturbance regime (e.g., fire, insects and disease, etc.). On the Carson, most vegetation communities can be described and mapped using the third taxonomy in this analysis, the ecological response unit framework. Ecological response units are map unit constructs, technical groupings of vegetation with similar site potential and disturbance history that define a spatial distribution on the landscape. In their definition, ecological response units include a desired distribution among seral states that is influenced both by natural processes and management. The acreages and modeling in this analysis are ecological response unit-based but aggregated or interpreted at the vegetation system level.

The ecological integrity of all vegetation communities on the Carson is currently at least slightly altered from both the reconstructed historic condition and desired conditions. The reasons for and degree of that departure vary by community and are summarized in table 16 and discussed in detail in the sections that follow.

Three impacts on current vegetation condition are pervasive; past practices of widespread selective logging, intensive unmanaged grazing, and fire-suppression had impacts that are still evident. Throughout the southwestern United States, 20th century fire exclusion, selective logging, and intensive unmanaged grazing significantly altered vegetative species composition and stand structure. Many of the largest, oldest trees were removed for timber, leaving smaller, younger trees and many legacy roads. Unmanaged grazing degraded watershed conditions and removed grass cover that carried fire. Fuels, in the form of dead woody material and living trees, built up because fires were less common and were usually extinguished quickly when they did start. Increased fuel loading has contributed to altered fire regimes in many of northern New Mexico's forests, woodlands, and shrublands.

Since the arrival of Euro-Americans, herbaceous understory vegetation has been reduced by increasing tree densities in established forest and woodland stands and encroachment of new forest, woodland, and shrub species into grasslands (Allen and Breshears 1998; Clary 1971). Total vegetative groundcover is departed from desired conditions in all vegetation communities on the Carson; anywhere from 14 to 59 percent. High-elevation forests are least departed. In the frequent-fire forests, herbaceous cover has been replaced by live trees or organic litter. The woodlands and shrublands are most departed with less than half their historic levels of herbaceous cover.

The risk ratings in table 16 account for current condition and trend and provide the basis for the affected environment discussions that follow.

Table 16. Summary of risk for terrestrial ecological response units

Ecosystem Characteristic	Alpine and Tundra	Montane Subalpine Grassland	Bristlecone Pine	Spruce-Fir Forest	Mixed Conifer with Aspen	Mixed Conifer Frequent Fire	Ponderosa Pine Forest	Piñon-Juniper Woodland	Piñon-Juniper Sage	Sagebrush Shrubland
Seral state	Low	Moderate*	Moderate	Low	Low	High	High	Low	Moderate	Moderate
Ecological status	Moderate	High	Moderate	Moderate	Low	Moderate	Moderate	Moderate	Moderate	Moderate
Groundcover	Moderate	Moderate	Moderate	Low	Low	Low	Moderate	Moderate	High	High
Coarse woody debris	Not Assessed	Not Applicable	Not Applicable Assessed	Low	Low	Moderate	Low	Moderate	Moderate	Not Applicable Assessed
Snag density	Not Applicable Assessed	Not Applicable	Not Applicable Assessed	Low	Low	Moderate	High	Low	Low	Not Applicable
Mean patch size	Not Applicable Assessed	Moderate	Not Applicable Assessed	Low	Moderate	High	High	Low	Low	High
Fire frequency	Not Applicable Assessed	Moderate	Low	Moderate	Moderate	High	High	Moderate	High	Moderate
Fire severity	Not Applicable Assessed	Low	Not Applicable Assessed	Moderate	Moderate	High	High	Moderate	High	Moderate
Fire Regime Condition Class	Low	Moderate	Moderate	Moderate	Moderate	High	High	Moderate	High	High
Insects and disease	Not Applicable Assessed	Low	Low	Moderate	Moderate	High	High	Moderate	High	Low
Soil condition	Moderate	High	Moderate	Low	Low	Moderate	Moderate	Moderate	High	High
Soil erosion hazard	High	Moderate	High	High	High	High	Moderate	Moderate	Moderate	Low

* The moderate departure in the montane subalpine grassland ecological response unit is based on woody species encroachment alone (38 percent departed). When departure due to ruderal species is also considered, departure is high (75 percent).

Alpine and Tundra Affected Environment

Alpine and tundra is a small but important vegetation community, found at the highest elevations of the Carson. It is present only on the Questa and Camino Real Ranger Districts, mostly in wilderness areas. While it is rare on the Carson, it is even rarer in the surrounding landscape. Alpine and tundra on the Carson has low departure from desired conditions. The Carson has a significant role in maintaining alpine and tundra, and to the degree that this vegetation community is less departed on the Carson than off the forest, is an important refuge for dependent organisms.

In some areas, alpine and tundra is impacted by past grazing and ongoing recreation. Until recently, most alpine areas on the Carson were grazed during the summer. This likely has altered species composition (Romme, Floyd et al. 2009) and has subjected some areas to wind erosion, leaving only the rocky substrate (Fletcher and Robbie 2004). Vegetative groundcover is 33 percent less than reference and ecological status is moderately departed, mainly reflecting a decrease in overall cover. Romme and others (2009), “speculate that general [historic] vegetation structure and distribution resembled what we see today...” Hikers and horseback riders mainly affect vegetation and soils in localized areas, but recovery from any damage is slow and not guaranteed (Pase 1994). Recent fire in alpine and tundra has been characteristically rare.

The threats to alpine and tundra include localized impacts from recreation. Given its current limited extent and elevation constraints, alpine and tundra is very susceptible to climate change on the Carson and is likely to decline in western mountain systems generally (USDA FS 2010c).

High-Elevation Forests—Bristlecone Pine Affected Environment

Bristlecone pine is the rarest vegetation community on the Carson, found only on the Questa and Camino Real Ranger Districts. The risk of not achieving desired conditions in the future is moderate. The Carson has a unique influence on the sustainability of the system. Departure may be higher on forest than off, and bristlecone pine may be an important vegetation community to restore at the plan scale.

On the Carson there is an overrepresentation of closed tree canopy and a decrease in vegetative ground cover overall. This may be the result of fire exclusion, but it is unlikely that just over a century of indirect human impacts have had a significant effect on a tree that can live for more than 2,400 years. On the Carson, there has been essentially no recent fire in bristlecone pine.

The greatest threats to bristlecone pine are insect and disease pathogens that are not currently active on the Carson but are active nearby. Mountain pine beetle (*Dendroctonus ponderosae*) is a native insect that favors lodgepole and ponderosa pine but may attack other species (Tomback et al. 2011). White pine blister rust (*Cronartium ribicola*) is a fungal infection, introduced to the Pacific Northwest around 1910. It has since spread through white pine and alternate species, including Bristlecone Pine, causing mortality in parts of New Mexico and Colorado, including the Santa Fe and Rio Grande NFs.

High-Elevation Forests—Spruce-Fir Forest Affected Environment

The spruce-fir forest (SFF) community is the third most abundant on the Carson, and common in the broader landscape. It occupies the coldest and wettest forested slopes, ridges, and valleys on every ranger district except Jicarilla. The risk of not achieving desired conditions in the future is low to moderate.

Departure in spruce-fir forest is mostly due to a legacy of timber harvest that removed old trees and built roads. Effects of logging between 1950 and the late-1970s are still evident in a shift of size classes from large to medium trees. Logging also removed organic matter from the system, an effect not caused by other types of disturbance (such as insects), which leave large standing and dead trees in place (Romme, Allen, et al. 2009). Snag and down woody debris abundance are less than half of desired condition.

Logging roads are prevalent and may affect spruce-fir forest more substantially than any other human-induced change through wildlife habitat loss, habitat dissection, increased edge, and decreased interior habitat (Romme, Floyd et al. 2009). Roads also have indirect or secondary effects, such as corridor avoidance by wildlife, roadkill, impacts from increased human access, and spread vectors for invasive species (Romme, Floyd et al. 2009; Watson 2005).

The current disturbance regime is not significantly altered from reference condition (Schoennagel et al. 2004; Vankat 2013). Characteristic insect, disease, and wind-throw events have occurred throughout the 20th century. While there have been few recent large fires in spruce-fir forest, long fire-free intervals are not inconsistent with desired conditions, and the ecological effects of fires that occurred have been typical (Romme, Floyd et al. 2009). The proportion of aspen exceeds that of the desired condition, but its distribution is probably not significantly altered (Romme, Floyd et al. 2009). There is a slight decrease in vegetative ground cover, likely a direct result of human disturbance, road construction, and concentrated recreation.

Spruce-fir forest has been subject to severe defoliation by the western spruce budworm (*Choristoneura freemani*, formerly *C. occidentalis*), a native defoliating moth that often causes the greatest defoliation to its preferred hosts, Douglas-fir, white fir, and spruce (USDA FS 2014c). Multiple consecutive years of heavy feeding by western spruce budworm can result in reduced tree growth, top-kill, and predisposition to bark beetle attack. Direct tree mortality can result from repeated defoliation and often occurs in the understory, where the trees are heavily fed upon by budworm larvae descending from the upper canopy.

Spruce-fir forest is moderately to highly vulnerable to climate change effects, particularly poor forest regeneration following stand-replacing fire and drought.

High-Elevation Forests—Mixed Conifer with Aspen Affected Environment

Mixed conifer with aspen (MCW) is less common on the Carson than it is in the surrounding landscape. It occurs on every ranger district except for Jicarilla. The risk of not achieving desired conditions in the future is low to moderate.

Compared to desired conditions, there is an overrepresentation of medium size classes, fewer large trees, and less aspen regeneration. Selective harvesting in the 1960s and '70s altered stand structures by removing high-value, large, overstory Douglas-fir trees, and shifting composition toward dense, moderate-sized true firs (Fruits 2014; Romme, Floyd et al. 2009). By contrast, natural disturbance kills many small trees, as well as some overstory trees of all fire-intolerant species (Romme, Floyd et al. 2009). Some killed trees remain in the system as coarse woody debris, as opposed to the complete removal that results from harvest. On the Carson, timber harvesting has reduced coarse woody debris by greater than two-thirds and there are slightly fewer snags per acre than there would have been historically. As in spruce-fir forest, legacy logging roads are common in most local zones.

The presence and distribution of aspen as a seral state in mixed conifer with aspen is dependent on fire. Most aspen stands establish following a crown fire and aspen regeneration is stimulated by fire (Jones and DeByle 1985; Margolis et al. 2007). While the extent of aspen occurrence is largely dependent on long-interval, stand-replacing fire, and therefore, may be similar to reference conditions (it is slightly underrepresented on the Carson), the structure of aspen stands is currently altered. Conifers as an understory component in aspen are increasing, as they are in the rest of the vegetation community, and the majority of aspen trees are mature to over-mature.

The vulnerability of mixed conifer with aspen to climate change at the plan scale is moderate to low, and is particularly low in the northern portion of the Tres Piedras Ranger District (USDA FS 2014a). However, fire frequency is regulated by late-melting snowpack and frequent summer rains (Romme, Floyd et al. 2009), both of which may be altered by climate change, increasing the risk of more frequent

stand-replacing fires. Spruce budworm will continue to be a persistent defoliator, but the warmer and drier conditions projected in future climate change scenarios could reduce budworm activity and temper severity of future budworm outbreaks (USDA FS 2014c). Root diseases often proliferate on stressed trees, so their significance increases following drought, which may become more likely with climate change. Infected trees, especially true firs and Douglas-fir, then become more susceptible to bark beetle attack (USDA FS 2014c).

Frequent Fire Forests – Mixed Conifer-Frequent Fire Affected Environment

The mixed conifer-frequent fire (MCD) community occupies warmer, dryer mixed conifer sites that support more frequent, low to mixed severity fire. It occurs on every ranger district except Jicarilla. The risk of not achieving desired conditions in the future is high.

Throughout the southwestern United States, 20th century fire exclusion, selective logging, and intensive unmanaged grazing significantly altered species composition and stand structure in mixed conifer with frequent fire communities. Many mature, large ponderosa pine and Douglas-fir trees have been replaced by dense stands of young trees (Reynolds et al. 2013) and closed tree canopies are overrepresented compared to desired conditions. Without fire, shade-tolerant, less fire-resistant species are able to establish and mature more easily. White fir and Douglas-fir have in-filled and become more common as dominant species, increasing stand density and species homogeneity (Reynolds et al. 2013). Aspen is much less common, occupying about one-sixth of its reference extent. Patch size has increased as large overstory trees were harvested, and mixed-severity fires no longer maintain heterogeneity (Reynolds et al. 2013).

The combination of dense, homogeneous forests and a shift toward less fire-resistant species results in fires that burn into the crowns of large trees and more intensely across the landscape. While fire frequency has been below historic levels, for those fires that have occurred, burn severities have been uncharacteristically high.

It is assumed that dense, crowded stands have also increased the potential for bark beetle activity to contribute to greater tree mortality when outbreaks do develop (USDA FS 2014c). Current stand structure encourages the expansion of dwarf mistletoe, resulting in direct mortality and slower growth of trees that do survive, along with other changes that together make forests more susceptible to damaging fire (Evans et al. 2011).

The vulnerability of mixed conifer – frequent fire communities to climate change at the plan scale is generally low (USDA FS 2014a). This community spans a wide climatic range from hot, dry, ponderosa forests to cool, moist, Spruce-Fir Forests, and incorporates characteristics of both. It may persist in the face of large climate fluctuations were it in a stable, resilient condition. However, secondary impacts of climate change, including more common fire and drought and more impact from insects and diseases, may stress already overgrown mixed conifer – frequent fire forests. Water-stressed mixed conifer forests would be more susceptible to bark beetle activity, and large-scale disturbances such as fire may help initiate some outbreaks, especially those of Douglas-fir beetle.

Frequent Fire Forests – Ponderosa Pine Affected Environment

The ponderosa pine forest community is the most abundant on the Carson and common on all ranger districts. Historic stand structure in Ponderosa Pine Forest has been well-documented and current conditions are clearly departed from historic structure. The function of the vegetation community is at high risk as a result.

As ponderosa pine trees mature, they develop adaptations that protect them from fire, including fire resistant bark, self-pruning lower branches, cones held high above the ground, open branches and needles that do not readily carry fire, deep roots, and thick bud scales (Vankat 2013). Historically, open stand

structure was maintained by frequent surface fire, which killed most small and shade tolerant trees, but left mature, fire resistant ponderosa pine. Beginning in the 1800s, heavy unmanaged grazing and subsequent fire suppression drastically reduced the frequency and extent of fires and allowed dense tree regrowth (Romme, Floyd et al. 2009).

Beginning around the turn of the 20th century and continuing into the 1950s, high-grade logging on what is now the Carson removed much of the merchantable timber from accessible ponderosa pine forest (Romme, Floyd et al. 2009). What remains in many areas are even-aged, relatively young stands that did not exist historically. Tree densities have at least tripled, patch size has increased, and structural diversity has decreased.

The desired fire regime is one of mostly low-severity fire, but as open spaces fill in horizontally and vertically, increased fuel continuity has resulted in wildfires that burn with extraordinarily high severity. Forests often follow uncharacteristic trajectories after stand-replacing fire, transitioning to dense ponderosa pine regeneration that is vulnerable to another fire or to non-forested grass/shrub vegetation states (Savage and Mast 2005).

Vegetative groundcover is sparser than desired. This is caused partially by human disturbance (e.g., road construction and concentrated recreation), but also by forest infill, which reduces the size of openings where percent cover, abundance, and diversity of grass-forb-shrub communities tend to be greatest (Reynolds et al. 2013). With additional tree cover and the effects of historic unmanaged grazing, the presence of herbaceous plants has been reduced in general, and some species may have become rare or extirpated entirely (Romme, Floyd et al. 2009). Decreased grass cover may also affect a reduction in mycorrhizal fungi, which support plant nutrition, nutrient cycling, and soil structure (Reynolds et al. 2013).

Southwestern dwarf mistletoe (*Arceuthobium vaginatum subsp. cryptopodum*) is the most damaging pathogen in ponderosa pine forest on the Carson. The parasitic plant is persistent and chronic, with infection rates ranging from 21 to 66 percent (USDA FS 2014c). There is general agreement that mistletoe severity and continuity throughout the Southwest has increased over the past century due to harvesting practices, and infilling and closure of forest canopies that allowed densely stocked young trees to become established under infected overstory seed trees, which resulted in an increase in the number of infected trees (USDA FS 2014c). Dense, crowded ponderosa pine stands have also increased the potential for bark beetle activity and contribute to higher mortality levels when drought-related outbreaks develop (USDA FS 2014c). Climate change is expected to increase stress and make forested environments more susceptible to pathogens in the future (USDA FS 2014c).

The greatest threat to ponderosa pine forest may be from uncharacteristic wildfire, which can significantly alter stand structure or result in type conversion to grass or shrub systems (Savage et al. 2013). Stand density and structural changes as a result of past human intervention produce tree mortality and burn severities that would not have occurred in the past (Allen et al. 2002). Larger and more frequent fires since 1986 have been closely linked to earlier spring snowmelt (Westerling et al. 2006), and a trend toward more years with earlier runoff has already been documented and is predicted to intensify under a warming climate (Barnett et al. 2008; USDA FS 2010c). Thus, climate change alone would be expected to increase the amount of fire in ponderosa pine forest, but with the added effects of anthropogenically altered stands, severe and frequent fires in the future seem inevitable.

Aspen Affected Environment

Aspen is an important component of frequent-fire and high-elevation forests. The desired conditions for aspen within these communities range from small, transient inclusions at lower-elevation, drier sites to more persistent and expansive early-seral patches at higher elevations. Aspen provides ecosystem services

including higher water yield than other upland forested types, forage, wildlife habitat, fire protection in some conditions, and aesthetic values that attract recreationists (DeByle and Winokur 1985).

Aspen stands are not permanent on the Carson. They occur as temporary seral states in other vegetation communities and are eventually overtaken by conifer infill. They may remain a part of the landscape where disturbance encourages aspen regeneration. Aspen is currently overrepresented in Spruce-Fir Forest but declining elsewhere. Everywhere that fire regimes have been disturbed by humans, conifers as an understory component are increasing and there is less opportunity for new aspen establishment. Fire in existing aspen stands would have been more common prior to heavy grazing by sheep during the late 19th and early 20th centuries. There is evidence that aspen historically supported a denser grass understory, which carried mixed-severity fires at shorter intervals, repressing conifer establishment and stimulating aspen sprouting (Jones and DeByle 1985). Maintained by this type of fire, aspen stands may have persisted more so in the past than they do today (Romme, Floyd et al. 2009). Direct browsing of aspen seedlings by wild ungulates and domestic livestock has been shown to reduce aspen regeneration, but to what degree or any anthropogenic influence on that impact has not been quantified (Romme, Floyd et al. 2009). Recent aspen mortality has been widespread, thought to be related to drought and chronic defoliation by western tent caterpillar (*Malacosoma californicum*) and large aspen tortrix moth (*Choristoneura conflictana*) over the last decade. This is a trend across the Carson and New Mexico, and while extensive aspen mortality may not be unprecedented, the species has decreased in abundance recently in the surrounding landscape (USDA FS 2014c).

Woodlands – Piñon-Juniper Woodland Affected Environment

Piñon-juniper woodland (PJO) is common in the Canjilon and Jicarilla Ranger Districts but occurs on all ranger districts. The risk of not achieving desired conditions in the future is moderate due to departed current soil and understory vegetation conditions.

While seral-state distribution is close to desired conditions, stand density has fluctuated recently from over-dense to more open as a result of a drought-related bark beetle outbreak from 2002 to 2004 that killed a significant portion of the piñon pine component in some woodlands of central and northern New Mexico (USDA FS 2014c). The denser condition lead to lower soil moisture and a corresponding decrease in understory cover (Jacobs 2008). In turn, these contributed to a significant reduction in vegetative groundcover. Groundcover is also reduced by high open and closed road densities. Cover from blue grama and sideoats grama, in particular, are both well below the desired condition.

A warmer, wetter climate since the late 1800s and increasing atmospheric carbon dioxide (CO₂) have favored increased extent and density of tree cover in piñon-juniper woodland. This infill and growth will likely continue, resulting in an increase in underrepresented, closed, late development stands and less departure from desired conditions. The predicted effects of climate change are expected to substantially change forest insect and disease dynamics (USDA FS 2014c). Even in the presence of normal precipitation levels in the Southwest, warmer temperatures alone could lead to tree mortality from moisture deficits caused by an increase in evapotranspiration (Adams et al. 2009). Periods of drought or even average precipitation levels exacerbated by higher temperatures and high stand densities could contribute to future widespread bark beetle outbreaks and tree mortality in piñon-juniper woodland (USDA FS 2014c). Continued increases in atmospheric CO₂ will favor woody species growth. A warmer, drier climate may increase fire frequency, but would be counteracted by reduced fine fuel production.

Woodlands – Piñon-Juniper Sage Affected Environment

The Piñon-Juniper Sage (PJS) community is common in the southern portion of the El Rito and Tres Piedras Ranger Districts but is found on every ranger district. The risk of not achieving desired conditions in the future is high.

Compared to piñon-juniper woodland, the sagebrush understory provides more continuous fuel to carry fire, and therefore, fire was historically more common and exerted a greater influence on stand structure. As a result, it is likely that fire exclusion and grazing have had a more substantial impact on departure in piñon-juniper sage than they have in piñon-juniper woodland. Low-intensity fires are unusual. Most fires remove the shrub layer and kill some to all trees (Romme, Floyd et al. 2009). The absence of fire has produced an overrepresentation of late-seral, closed tree states. There is also an overrepresentation of early-seral grass/forb/shrub states. Shrubs or bare ground have replaced trees in areas that were chained, plowed, and crushed. As many as 20,000 acres of these treatments may have been applied to piñon-juniper sage during the 1950s and '60s (9.3 percent of the vegetation community). The remaining 10 to 11 percent that has moved from a treed to open state may be the result of historic overgrazing, drought, tree harvest, or a combination of factors. The 2002–2004 bark beetle outbreak described for piñon-juniper woodland had similar effects on piñon-juniper sage. Mortality was greatest at lower elevations and on drier sites, the same areas that favor piñon-juniper sage over piñon-juniper woodland (USDA FS 2014c).

The combined effects of grazing and increased tree canopy have resulted in decreased grass cover. Piñon-juniper sage is the most departed vegetation community in terms of vegetative groundcover.

Piñon-juniper sage is highly vulnerable to climate change, and a warmer, dryer climate may affect fire regimes in piñon-juniper systems with a sage component more than those piñon juniper systems where fire is carried mainly by the tree overstory (Romme, Floyd et al. 2009).

Shrublands – Sagebrush Shrubland Affected Environment

The sagebrush shrubland community is one of the least common on the Carson, occurring mostly on the Tres Piedras and Jicarilla Ranger Districts. The risk of not achieving desired conditions in the future is moderate to high.

On the Carson, the open herbaceous state and the late development shrub state are underrepresented. The actual percent canopy cover of sagebrush in the vegetation community is less than the desired condition, having been replaced by other shrub species, like broom snakeweed (*Gutierrezia sarothrae*) and fourwing saltbush (*Atriplex canescens*). All grama species have declined significantly. Sideoats grama (*Bouteloua curtipendula*) and black grama (*Bouteloua eriopoda*) are nearly absent. Total vegetative groundcover is substantially below desired conditions (-52 percent) as a result of degraded soils, drought, and grazing. Tree encroachment is currently less extensive on the Carson than it is in the broader landscape, but it is expected to continue. This future expansion may be tempered by increased insect and disease-related mortality on marginal tree sites and fire.

Sagebrush shrubland is the vegetation community least vulnerable to climate change on the Carson.

Grasslands Affected Environment

Grasslands occur across the Carson, as the montane subalpine grassland vegetation community, the herbaceous riparian community, and as a seral state in forests and woodlands. These grasslands range from small patches to large areas covering hundreds of acres. They contain several plant associations with varying dominant grasses and herbaceous species. The reference fire regime for grasslands is typically driven by the fire regime of the surrounding forest type. Those adjacent to frequent fire forests have a fire rotation interval of less than 24 years. Those surrounded by high-elevation forests or in riparian areas likely only burned at the edges and far less frequently.

Primary threats to this vegetation group are competition from overabundant woody species, legacy grazing impacts, induced shifts in species composition, and the continuation of combined wild and domestic ungulate grazing.

Grasslands – Montane-Subalpine Grassland Affected Environment

The montane-subalpine grassland community is a mix of a diverse variety of grass communities that may occur at a wide range of elevations. It is naturally fragmented, occurring as meadows and openings surrounded by spruce-fir, mixed conifer, and ponderosa pine (Vankat 2013). It is often interspersed with the herbaceous riparian vegetation community. It occurs on the Carson on every ranger district except the Jicarilla. The current condition is moderately departed from desired conditions. Based on its distribution on the forest and on the surrounding landscape, the sustainability of the system at the context scale is sensitive to conditions at the plan scale, and the Carson, therefore, has a unique role in restoring or maintaining integrity when possible.

Species composition in montane-subalpine grassland has been altered by a legacy of heavy unmanaged grazing, continued managed grazing, fire exclusion, seeding with nonnative grasses, and drought. There is a general reduction in fescue bunchgrass species, indicative of drought and a grazing preference by herbivores (Fletcher and Robbie 2004). This shift in species composition from bunchgrass dominance to sod-forming grasses and forbs, and the resulting reduction in overall litter and groundcover, are consistent with long-term trends documented elsewhere in the broader landscape (Romme, Floyd et al. 2009; Zier and Baker 2006). Blue grama is more drought-tolerant and less impacted by early season grazing and its cover has increased. The same is true of introduced species, such as Kentucky bluegrass and crested wheatgrass (*Agropyron cristatum*).

Currently, 37 percent of montane-subalpine grassland on the Carson is dominated by ruderal species that permanently prevent the system from returning to another state. The most common among these species is Kentucky bluegrass, though other (mainly introduced) species are present.

Overall, current vegetative groundcover is moderately departed (41 percent) from desired conditions (USDA FS Carson NF 1987). This is mainly the result of human disturbance, road construction, and areas of concentrated recreation and grazing.

There is an overrepresentation of an uncharacteristic tree/shrub state, as a result of reduced fire, climate change, and decreased herbaceous competitive ability due to overutilization by large herbivores (Fletcher and Robbie 2004; Vankat 2013; Zier and Baker 2006). Tree and shrub encroachment has resulted in a reduction in average patch size and montane-subalpine grassland is more fragmented with less connectivity and less total acreage than there would have been historically (Fletcher and Robbie 2004), which reduces the amount of available habitat for grassland-associated species and forage for livestock and wildlife.

The montane-subalpine grassland community has low vulnerability to climate change on the Carson. However, drought probability and severity are likely to increase in the future (USDA FS 2010c), leading to reduced grassland productivity, lower overall groundcover, shifts in species composition, and soil instability. Stressed grasslands would be more susceptible to invasive species invasion and invasive species management would need to continue to limit their establishment and spread. Woody species encroachment and infill is likely to continue. There is evidence that much of the 20th century tree expansion was driven by unusually wet periods, but even in a drier future climate, increased atmospheric CO₂ concentrations may favor woody species in grasslands (Ford et al. 2012).

Riparian – Wetland Riparian Affected Environment

The wetland riparian (WR) vegetation community includes open water wetlands, slope wetlands, marshes, wet meadows, cienegas, bogs, and fens. Wetland riparian is extensive and inclusive, occurring at nearly all elevations on the Carson. It supports a wide diversity of riparian and wetland herbaceous species that can vary widely with elevation, water availability, as well as biophysical characteristics (i.e., gradient, salinity), but sedges and rushes are particularly important to system function. It is most common

in wide, low gradient meadows where the water table is seasonally high, soils are saturated, and trees or shrubs are mostly absent.

The risk of not achieving wetland riparian desired conditions in the future is moderate. In some places, particularly at lower elevations, flood regimes have been moderately altered, instream flows are reduced, and their timing is altered by human water uses (Romme, Floyd et al. 2009). Decreased flooding, channelization, downcutting, and lowered water tables all contribute to a reduction in available soil moisture and an increase in upland species. Species composition is highly departed, riparian vegetative cover is moderately departed, and uncharacteristic shrub and tree cover are common. Species composition and riparian vegetative cover have been altered by changes resulting from historic overgrazing and continued grazing, fire exclusion, concentrated recreation, and dewatering from surface and groundwater withdrawal, upland species encroachment, or channel incision. Measured changes include woody species encroachment, a slight decline in sedges, conversion of native bunch grass cover to (mostly introduced) sod forming grass cover, and the spread of invasive species, all of which are likely to continue in the future. Though overall vegetative groundcover is similar to historic levels, in some areas of the Carson vigor is significantly reduced, and species composition is altered due to historic and current management. Loss of hiding, breeding, and forage cover degrades species habitat and is a major impact in some areas. Reduced cover and dominance by sod-forming grasses negatively affects stream temperature, bank stability, and sedimentation.

Threats to wetland riparian include invasive species and more frequent, climate change-related drought. Invasive species were originally spread mainly along roadways, but are becoming increasingly established in riparian areas, distributed by stream flows (USDA FS 2005).

Riparian – Forest and Shrub Riparian Affected Environment

The forest and shrub riparian (FSR) community occurs across the Carson in different forms depending on elevation, adjacent upland species, and site-specific conditions. The overstory may be shrubby in the case of willow-thinleaf alder sites, or tree-dominated with a variety of species depending on elevation and site conditions, including spruce, narrowleaf cottonwood, and Rio Grande cottonwood. Willow species are common in the understory. Drought and flooding are the primary natural disturbances. Fire is an infrequent disturbance but may enter from adjacent vegetation types during dry periods. Fire effects are generally less severe than in the surrounding uplands.

Departure from desired conditions ranges from low to high with higher elevation sites generally being less departed, though site-specific factors and history are dominant influences. Lower-elevation sites are more departed due to greater human activity, including water withdrawal, diversion, and storage; agriculture; livestock grazing; recreation; and seeding with nonnative species. Degradation at lower, drier elevations is compounded by adjacent upland systems with inherently less groundcover, and less capacity to recover. Legacy impacts from intensive, unmanaged grazing, fire suppression, and beaver trapping are still evident in many forest and shrub riparian communities.

Flood regimes range from minimally altered at high elevations to substantially altered and departed from desired conditions at lower elevations or near developed areas. It has been altered by water withdrawals, diversion, and storage, as well as by changes to channel shape and function. Channel confinement results in faster runoff because water is not being stored or delayed. Channel confinement may result from incision or from roads built in the floodplain that restrict flood flows. Flood regime impacts are cumulative, that is, upstream alternations also affect downstream flows. Therefore, flood regimes are least impacted in upper montane conifer-willow sites, which occur mostly at high elevations. Narrow-leaf cottonwood and Rio Grande cottonwood sites occur downstream at lower elevations and have been, and still are more altered by human development and activities.

Beaver activity is generally less than desired, which affects water impoundment and flood plain development. There are many fewer beaver dams on the Carson now than in the past, due to historic beaver trapping. There is anecdotal evidence that beaver populations have recovered in some areas and that the trend in beaver activity is improving or stable. Rio Grande cottonwood sites are the exception as beaver have not recovered here.

Upland watershed conditions vary according to the adjacent vegetation community, but conifer encroachment into the riparian area is a common issue. Willow-thinleaf alder sites intersect with mostly frequent-fire forest uplands, which are at high risk from uncharacteristic wildfire and subsequent erosion, and are susceptible to insect and disease damage. Tree stands are crowded, and more water is lost to transpiration, leaving less to support riparian function. Upper montane conifer-willow sites are mostly surrounded by high-elevation forests, which have lower departure and, for the most part, regulate hydrologic function and sediment delivery. Other FSR types are surrounded by upland vegetation communities that are moderately departed or a mix of departed and less departed uplands.

Age classes of riparian species in the FSR community have not been specifically measured. Generally, there are multiple canopy levels present, which may indicate distribution among age classes of riparian species, but it may also reflect understory invasion by upland species, or even conversion to mainly upland species. Multiple canopy levels do not necessarily indicate that there is adequate riparian species recruitment or replacement; therefore, the condition of age class distribution is unknown. Rio Grande cottonwood sites are an exception. There are fewer than two canopy levels, indicating that recruitment of all species is lacking, and that Rio Grande cottonwood in particular are not reproducing. This trend has been observed anecdotally on the Carson and has been documented throughout New Mexico (Dick-Peddie 1993). It reflects the significant alteration in flow regime, and a history of heavy, unmanaged grazing (Dick-Peddie 1993).

Species composition is similar to desired conditions on some sites but not others, resulting in reduced riparian adaptive capacity. In general, sedges and rushes are less common than they were historically, and sod-forming, shallow-rooted grasses have become much more common than native perennial bunch grasses; a legacy of past intense, unmanaged grazing and subsequent seeding with annual grasses. On Willow-thinleaf alder sites, fire exclusion has had a substantial impact as fire adapted uplands have expanded into riparian zones and reduced available water. Rio Grande cottonwood sites have been impacted by heavy, unmanaged grazing, agricultural conversion, and substantial streamflow regulation, resulting in much less understory cover and low reproduction. Narrowleaf cottonwood regeneration and cover is reduced, most noticeably at lower elevations where flow alteration is compounded. Upper montane conifer-willow sites occur at higher elevations and have been less impacted by human activity. They are affected by drought, which shrinks the riparian zone, and by fire exclusion, which encourages conifer encroachment.

Ecological status, or the similarity of current vegetation composition to the potential natural community is at least moderately departed in the FSR community, and highly dissimilar in willow-thinleaf alder and Rio Grande cottonwood-shrub sites mostly due to a lack of willow species. There are also declines in alder species and increases in conifers and Kentucky bluegrass.

Coarse woody debris and riparian vegetative cover are slightly to moderately lower than desired conditions. Some streams are kept free of debris for irrigation efficiency, particularly at lower elevations, and in streams that are highly regulated large wood is not deposited by flooding. Vegetative cover is moderately impacted in some areas. To some extent, this is a result of conversion from bunch grasses to sod-forming grasses, but mainly it is due to wildlife and livestock grazing and concentrated recreation that trample or remove large amounts of above-ground vegetation.

There are examples of functional communities on the Carson representative of each forest and shrub riparian type, but all currently face some risk to their continued function. Future impacts from fire, drought, invasive species, and climate change will stress them further.

Environmental Consequences for Vegetation Communities and Fuels

Methodology and Analysis

The analysis for vegetation uses state-and-transition modeling to predict and compare the effects of alternatives. State-and-transition models treat vegetation age, composition, and structure as “states”, connected by transitions that represent disturbance and vegetation development over time. This modeling approach builds on transition matrix models that represent vegetation development as a set of transition probabilities among various vegetation conditions/seral states. These transition probabilities incorporate both natural vegetation growth/succession and disturbances such as insects, disease, harvesting, and severe weather events.

Projected trends in the distribution of vegetation between states (or transitions) under each alternative were developed using the Vegetation Dynamics Development Tool. The Vegetation Dynamics Development Tool is a software program that provides a state-and-transition modeling framework to examine the role of various transition agents and management actions in vegetation change (ESSA 2007).

The forest has limited capacity in the anticipated 15-year lifespan of the revised plan to reverse trends in all vegetation types and move them all toward desired conditions. Limitations are imposed by limited and fluctuating funding, current lack of a market for small-diameter biomass to offset cost of treatments, and length of time required to accomplish and approve planning for treatments. Acknowledgement of limited capacity necessitated the development of priority needs for change to focus efforts during the planning period. Three focus areas developed during the needs for change specifically related to vegetation conditions include:

1. Restore frequent fire forests. Fire-dependent ecosystems (ponderosa pine and mixed conifer-frequent fire) are the most highly departed ecosystems on the forest. Lack of fire has led to closed canopies, increased fuel loads, altered species composition, and highly stressed vegetation.
2. Improve grasslands and herbaceous cover. Montane-subalpine grasslands and other vegetation communities have experienced dramatic reductions in grass and herbaceous cover and productivity. Lack of grass and herbaceous cover has influenced accelerated erosion and declining soil productivity forestwide for many vegetation communities.
3. Promote aspen health and resilience. While aspen is common, it is declining on the Carson and in the broader landscape due to increased conifer encroachment and dominance, drought, and fire exclusion.

Indicators

Ecological Integrity

Forest plan direction must provide for ecological integrity while contributing to social and economic sustainability (36 CFR 219.1). Ecological integrity is the ability of the ecosystem to withstand (resistance), recover from (resilience), or adapt to most stressors imposed by natural or human influences, and to sustain natural ecological function into the future. Overall ecological integrity forms the basis for the comparison of alternatives for vegetation communities. How well alternatives maintain ecological integrity is measured by how well they achieve the desired conditions for each vegetation community.

Desired conditions for vegetation were developed based on a broad range of scientific publications covering topics including wildlife and forest ecology, restoration principles, economics, and ecosystem

services and are well supported by broad-based, peer-reviewed science. Often, they are similar to reference conditions and fall within the historic range of variation of pre-European settlement southwestern ecosystems, prior to widespread interruption of natural fire regimes, tree harvests, and livestock grazing. The historic range of variation reflects those ecosystem conditions that supported the assortment of wildlife and plant species that existed on the Carson prior to widespread human influence. As such, they reflect ecosystem conditions that will most likely sustain those wildlife and plant species into the future. Desired conditions may also account for the existing or anticipated human use patterns or desires for specific vegetation conditions, or the ecosystem services desired from lands managed by the Carson NF, such as protection from wildfire or production of forest products. Desired conditions are designed to: (1) promote native plants and animals, forage production, wood products, visual quality, trophic level interactions, and ecosystem function; (2) restore or maintain old-growth and hydrologic function; (3) reduce fire hazard and improve the ability to manage wildland fire; (4) increase resilience and resistance to insects, disease, and climate change; and (5) facilitate ecological adaptation of ecosystems to future threats to biodiversity.

Restoring and maintaining desired vegetation structure, composition, pattern, and process minimizes the vulnerability of ecosystems to disturbance, such as wildfire, flooding, or climate change (USDA FS 2010c). Management that makes the most progress toward desired conditions, including restoring historic fire regimes, produces the greatest resistance, resiliency, and adaptability to climate change and other stressors.

Future climate change is likely to exacerbate the effects of natural and altered disturbance regimes, including wildfire, insect outbreaks, flooding, and erosion across all Carson vegetation communities and may prompt abrupt ecological changes. Focusing on strategies that increase overall resilience and resistance provides reasonable assurance of these communities' ability to adapt to uncertainties of changing climate. Moving current forest, woodland, and grassland vegetation composition and structure toward desired conditions and restoring historic ecological disturbance regimes minimizes loss of function (USDA FS 2010c) and thereby improves resistance and resilience to uncertain future disturbance, such as wildfire, flooding, climate change, or human use. The closer ecological composition, structure, and process are to reference conditions, the more properly the system is functioning and the more secure dependent species (plants and animals) are within their associated habitats.

Reestablishing the structure, composition, pattern, and processes necessary to make these ecosystems resistant, resilient, and adaptable is of primary importance to maintaining their biodiversity and assuring their continued existence. Each alternative is assessed for its combined movement toward desired conditions. How well alternatives achieve or move toward desired conditions is an indication of how well the alternative provides for ecological integrity. Measures of integrity vary by vegetation type. Key ecosystem characteristics were identified during the assessment of current conditions and trends to assess current and future departure (the degree to which the integrity of a system has been compromised). Departed current condition, or a trend toward higher departure suggests that ecological integrity is at risk.

Some key ecosystem characteristics are applicable in some cases but not others; some are easily quantifiable in some cases but not others. Indicators have been chosen for this effects analysis that are either themselves key ecosystem characteristics or are indicative of integrity to which key ecosystem characteristics contribute. What follows are descriptions of those indicators that are measurable, vary by alternative, and therefore provide a basis for comparison. The relationship of each indicator to ecological integrity and the methods for modeling or predicting effects in this analysis are discussed below. These are indicators of integrity, not an exhaustive list of all factors that may impact integrity or that may vary among alternatives:

- Seral state proportions (percent)
- Fire regime (frequency and severity)

- Old-growth structure (acres)
- Snags and coarse woody debris (number, tons per acre)
- Herbaceous understory (acres of open seral states)

Seral State Proportions

Each vegetation community can manifest in a range of potential overstory conditions, each representing a unique phase in the overall ecology of the system (Weisz et al. 2009). By grouping these phases into seral state classes with unique vegetation characteristics (overstory age, composition, and structure), models can be developed that define transitions among phases. The seral state proportion is the percent of a vegetation community in each of these seral states at a given time. Desired seral state distributions were developed to reflect desired conditions in the plan based on best available scientific information and reflect the natural range of variability. The closer seral state distributions are to desired conditions, the more likely species composition, structure, and processes are within their natural range of variability and the more ecological integrity is intact.

A state-and-transition model was developed by vegetation community and calibrated to reflect the anticipated management under each alternative. Initial seral state proportions were assigned according to actual measurements of current conditions on the Carson (see appendix C).

Treatments may modify seral state distribution by reducing the volume of vegetation in the tree canopy, reducing canopy continuity with the creation of interspaces, or openings, and promoting a more abundant grass/forb understory that, in turn, helps maintain ecological integrity. Open canopy conditions and understory herbaceous density and diversity are important to restore historic fire regime and ecosystem resiliency, especially in frequent fire forests (Fulé 2008).

Old-growth Structure

As an important part of the landscape ecology of natural forests, old-growth forest structure provides unique ecosystem services including plant and animal habitat, high quality wood products, carbon sequestration, hydrologic function, aesthetics, and spiritual value. Old-growth structure is a significant and unique part of the diverse ecological web formed by natural forest landscapes. However, because of the complex and dynamic nature of forests, efforts to conserve biodiversity by providing old growth in landscapes must consider all developmental stages, not just old growth (Spies 2004). Presence of old trees is just the beginning of a description of the composition of an old-growth forest (Binkley et al. 2007), but old-growth forests, by definition, have old trees. Old growth is the product of structures and processes associated with the maturation and senescence of a population of trees (Spies 2004) and requires old trees, but also snags, dead and downed large woody debris, and structural variability.

Old trees are not necessarily large trees. Inferences about age distribution may be made from size class distribution, but size class distribution does not correlate directly with old-growth characteristics. Tree size depends on species and site characteristics (moisture, soils, and competition). However, this analysis focuses on tree size, not age, because it is measurable by alternative at the forestwide scale. Large trees themselves provide many of the same benefits as old-growth structures, including merchantable wood products, carbon sequestration, and social value.

For this analysis old-growth structure in forested vegetation communities is inferred by the percentage of modeled late seral states under each alternative.

Snags and Coarse Woody Debris

Ecologically, a dead tree is as important to the forest ecosystem as a live one and, according to Marcot (2002), provides several key ecological functions that influence the ecosystem through trophic relations,

species interactions, soil aeration, primary cavity and burrow excavation, and dispersal of fungi, lichens, seeds, fruits, plants, and invertebrates. Snags (standing dead trees) and fallen, rotting logs are essential to forest ecosystem function in several ways. Snags provide cavity and nesting sites for birds and roosting sites for bats. When snags fall and become coarse woody debris, they provide habitat for small animals and insects. When these logs rot they store water and provide nutrients for continued forest growth. Dead wood rotting on the forest floor is eventually incorporated into the soil. This underground wood feeds insects and bacteria that provide nitrogen to feed trees and other plants in the forest. Underground wood is the major source of nitrogen for dry forests.

Importance of coarse woody debris in forests has been partially documented, although much remains to be discovered (Stevens 1997). What is known is divided into four inter-related categories: (1) the role in productivity of forest trees; (2) the role in providing habitat and structure to maintain biological diversity; (3) the role in geomorphology of streams and slopes; and (4) the role in long-term carbon storage. The importance of each to an ecosystem varies among forests based on natural disturbance regime and the site's ecological potential (Stevens 1997).

Forest inventory and analysis plot data were used to develop snag and coarse woody debris averages by seral state for each vegetation community. Those coefficients were then applied to modeled seral state distributions for each alternative to estimate total coarse woody debris volume, number of snags larger than 8 inches, and number of snags larger than 18 inches.

Herbaceous Understory

Herbaceous understory vegetation and grassland vegetation provide habitat, hiding and thermal cover, nesting sites, and food sources for a myriad of plant and animal species. In addition, herbaceous understory vegetation contributes to organic matter needed for soil development and fine fuels that maintain and support natural fire regimes.

Total vegetative cover, comprised of live overstory and understory vegetation plus dead organic material, is indicative of herbaceous understory condition, though it is also affected by other factors. For example, dense overstory vegetation may increase total vegetative cover through basal area and dead needle cast, but it may suppress herbaceous understory through shading, competition, and a thick layer of needles that inhibits grass production. Total vegetative cover is important for soil stability, water capture, and moisture retention. Reduced overall ground cover can reduce productivity, change runoff timing and quantity, increase erosion potential, and increase sedimentation. Cover that occurs as live herbaceous material provides additional habitat, nutrient cycling, and forage benefits. By considering the combination of open seral states and total vegetative cover, the amount of herbaceous understory production can be inferred.

There is strong evidence in some vegetation communities that more open tree canopies result in increased herbaceous understory vegetation production. Jameson (1967) found more than a two- to three-fold increase in herbaceous understory vegetation production between open (less than 30 percent) and closed (greater than 30 percent) canopy sites in ponderosa pine forests. Moore and Deiter (1992) also reported that understory herbaceous plants (i.e., grasses, sedges, forbs) had a predictable positive response to overstory ponderosa pine canopy cover reduction. In piñon-juniper woodlands, canopy cover has a greater impact on species composition than on overall herbaceous cover (Pieper 1990). The extent that understory vegetation responds to overstory removal also depends on the health and condition of the existing understory community and its ability to respond as well as available seed bank and soil productivity.

Fire Regime

Fire is an integral component in the function and biodiversity of many natural habitats and organisms, and most vegetation on the forest has evolved under fire's influence. Fire is regarded as a natural disturbance,

similar to flooding, wind-storms, and landslides, that has driven evolution of species and controls characteristics of ecosystems.

Each vegetation community has a characteristic fire regime that is integral to its ecological integrity. A fire regime is a generalized description of the role fire plays in an ecosystem and is characterized by how often fires typically burn and their extent, seasonal timing, and effects. Frequency and severity of wildfire varies among vegetation communities, but each community on the Carson is adapted to withstand and even exploit a characteristic level of fire. Climatic conditions factor greatly into the size, extent, and severity of fires. Historically, extended periods of warm, dry climatic conditions tended to be associated with larger, higher-severity, and more widespread fire events. Periods of cooler, moist climatic conditions tended to be associated with smaller, less severe fires. The Carson's management influences fire regimes in two ways, through manipulation of burnable fuels with mechanical or prescribed fire treatments and through the amount of fire that is allowed to occur on the landscape (both planned and unplanned ignitions). In this analysis the impact of alternatives on fire regimes is measured through a combination of the desired amount of fire, the location of fire on the landscape, and the degree to which predicted fuel conditions promote desired fire behavior.

Other Key Ecosystem Characteristics

Four additional key ecosystem characteristics were not explicitly modeled or predicted, but in some cases, they may be inferred based on those indicators that were:

- Vegetation composition (ecological status)
- Patch size
- Insect and disease
- Fire Regime Condition Class

Species Composition (Ecological Status)

Site potential or ecological status is the degree of similarity between the existing plant community composition and the potential natural community (PNC), as described in the Terrestrial Ecosystem Survey of the Carson National Forest (USDA FS Carson NF 1987). The similarity analysis results in an index value that considers all plant species collectively. The PNC is not necessarily a management goal in itself since it defines the climax of succession. The PNC along with the earliest successional stage determine the range of conditions that should prevail in a healthy ecosystem.

Species composition may be influenced by disturbance such as fire, insect and disease, invasive species, grazing, or mechanical manipulation. The Carson has significant influence through fire and grazing management in particular.

Patch Size

Patches are contiguous areas in which the vegetation composition and structural state are relatively homogeneous and differ from their surroundings. Patches can be composed of randomly arranged trees, shrubs, or grasslands; groupings of trees and shrubs; and may be even- or uneven-aged. Vegetation patterns, including patch size and distribution, reflect the cumulative and interactive effects of disturbance regimes (e.g., insects, disease, fire, etc.), biophysical environments (e.g., topography, soils, climate), and successional processes (Baker 1989; Keane et al. 1998).

Patch arrangement is an important determinant of insect or disease outbreak and fire spread. It is also an important element of wildlife habitat. Each species has its own patch size preference, and the strength of these preferences vary by species. The desired distribution of patches resembles the distribution under

reference conditions, so as to best accommodate the varying preferences of all wildlife species and mimic historic disturbance behavior.

Insects and Disease

Insects and diseases are important disturbance agents and contributors to ecosystem function in forest and woodland ecosystems and are characteristic to some degree and at some frequency in all vegetation communities. They can profoundly influence forest structure and species composition over time. While insect and disease impacts often conflict with human objectives and forest management goals, their effects on the forest may be detrimental or beneficial from an ecological perspective (USDA FS 2014c). Desired conditions are based on historic ranges of variability that have supported endemic levels of insects and diseases in the past. While stand structure and composition contribute to insect and disease distribution and success, other factors such as water stress and annual temperatures are interrelated drivers that are often outside of Forest Service management control.

Fire Regime Condition Class

Fire regime condition class is a combination of seral state departure and fire regime departure into a single metric. Fire regime condition class ratings describe a level of departure from native ecosystems as they existed prior to Euro-American settlement:

Fire regime condition class I – Fire regimes are within the natural range of variation, and risk of losing key ecosystem components is low.

Fire regime condition class II – Fire regimes have been moderately altered. Risk of losing key ecosystem components is moderate. Fire frequencies may have departed by one or more return intervals, potentially resulting in moderate changes in fire and vegetation attributes.

Fire regime condition class III – Fire regimes have been substantially altered. Risk of losing key ecosystem components is high. Fire frequencies may have departed by multiple return intervals, potentially resulting in dramatic changes in fire size, fire intensity, and fire severity, as well as landscape patterns.

Assumptions

- The closer vegetation composition, structure, and processes are to the desired condition the more properly the community is functioning and the more secure dependent species (plants and animals) are within the associated habitats.
- The departure of areas that are treated using fire or mechanical methods is assumed to improve due to alteration of the structure and composition of vegetation and fuels. Treatments are assumed to move vegetation toward desired conditions.
- Actual acres treated under each alternative will depend upon resource availability, NEPA analysis, weather conditions, the socio-political environment, and other unpredictable factors.
- There is no surrogate for the application of fire in frequent fire ecosystems. It is critical to ecological restoration in that it provides nutrient cycling, species selection, resprouting stimulus, and other benefits that cannot be achieved mechanically.
- For each vegetation community, the closer its ecological composition, structure, and processes are to reference condition (low departure indices versus high departure indices), the more properly the system is functioning, and the more secure dependent species (plants and animals) are within their associated habitats.

Environmental Consequences for Vegetation

Environmental Consequences for Vegetation Common to all Alternatives

Under all alternatives, vegetation would be managed to be healthy and diverse, providing sustainable wildlife habitat, forest products, and recreational opportunities. There would continue to be vegetation management, including removal of trees to restore diversity, improve habitat, provide wood products, and protect values from disturbance (forest thinning around homes, tree harvest to slow disease spread). These management actions may have short-term, localized, negative impacts on soil condition (degradation), understory vegetative cover (reduction), and wildlife habitat (temporary loss or displacement).

Livestock grazing would continue under all alternatives. Grazing and browsing by permitted livestock and wildlife effects species composition and abundance, which in turn influence fuel loading and fire regimes. Removal of surface biomass limits fire spread and can alter species composition by favoring more fire-sensitive species. Grazing management including timing and stocking levels can dramatically impact vegetative ground cover and species composition. All alternatives would manage grazing by allotment based on range capacity in order to maintain ecological process and function (e.g., water infiltration, wildlife habitat, soil stability, and natural fire regimes). There is direction under all alternatives to adaptively manage permitted grazing, to maintain wild horse populations according to wild horse territory management plans, and work in cooperation with other agencies and landowners to manage wildlife.

Vegetation would be impacted by future climate fluctuations in ways that are not entirely predictable. As stated in the synthesis report of working group summaries from the Intergovernmental Panel on Climate Change (IPCC 2014), it is clear that atmospheric carbon dioxide (CO₂) and other greenhouse gas concentrations are increasing and that this increase is causing, and will continue to cause, major changes in global climate. There is broad agreement among climate models that the southwestern U.S. is experiencing a warming and drying trend that will continue well into the latter part of the 21st century (IPCC 2007a; Seager et al. 2007; USDA FS 2010c). A changing climate would alter species range, type, and abundance throughout the Southwest. Responding differently to shifts in climate, the somewhat tenuous balance among ecosystem components would also change. The overall effects among interacting species and disturbance are difficult to predict, particularly given the rate of climate change and the ability of symbionts to adapt (USDA FS 2010c). Yet, should vegetation cover and moisture-exchanging properties of the land change, important local and regional climate characteristics would also change, with potential compounding effects to vegetation (Sprigg et al. 2000).

Under the predicted future climate, vegetation would experience more extreme disturbance events including wildfire, flash flooding, and wind events (Swetnam et al. 1999) and new disturbance regimes are likely to result in significant perturbations to U.S. forests (Joyce and Aber 2001). The effects of these events vary by the particular disturbance and vegetation type, but would tend to move community distributions toward earlier seral states and may result in shifts to novel successional pathways (Savage and Mast 2005). Many ecosystems on the Carson contain water-limited vegetation today. Vegetation productivity across the Southwest may decrease further with warming temperatures, as increasingly negative water balances constrain photosynthesis (USDA FS 2010c). Weakened vegetation communities are likely to be more vulnerable to invasive species that are adapted to the novel climate (Joyce et al. 2007). Invasive species may outcompete or weaken native species. There may be long-term shifts in vegetation patterns as species are no longer able to survive on some sites but colonize new ones (Millar et al. 2007; Westerling et al. 2006). High-elevation, cold-tolerant vegetation may disappear in some areas where acceptable sites no longer exist (Clark 1998; Joyce et al. 2008).

As has occurred in the past, increasing fire disturbance superimposed on ecosystems stressed by drought, insects, and disease may have significant negative effects on growth, regeneration, long-term distribution and abundance of forest species, and carbon sequestration. Based on a climate change vulnerability assessment conducted by Region 3 of the USFS (USDA FS 2014a), there is moderate to high uncertainty

surrounding the potential for significant alteration of structure, composition, or function for most vegetation communities on the Carson NF. Three notable exceptions are the Piñon-Juniper Sage, Sagebrush Shrubland, and Montane Subalpine Grassland vegetation communities for which there is moderate to high certainty. With high certainty, Piñon-Juniper Sage is highly vulnerable, probably because it occurs on some of the most marginal, low elevation sites on the Carson NF. High vulnerability may indicate either that the area is on a marginal limit of current climate, or that the climate in the area is predicted to shift far from the current envelope for the community, or a combination of both. In either case, Piñon-Juniper Sage is likely to experience altered structure, composition, or function in the future. With high certainty, Sagebrush Shrubland and Montane Subalpine Grassland have low vulnerability, possibly reflecting their ability to succeed on warmer sites than currently exist on the Carson NF.

Oil and gas development and production currently occurs within the Jicarilla Natural Gas Management Area. The short- and long-term consequences could include removal of vegetation to site infrastructure. Co-location of pipeline, road, and other infrastructure, road design limitations, and well siting measures that limit surface disturbance would minimize vegetation disturbance.

Environmental Consequences for Vegetation—Alternative 1

The 1986 Forest Plan does not explicitly describe desired conditions for overall vegetation composition or process, nor are there any specific numeric desired ranges for forest composition either forestwide or by management area. However, the 1986 Forest Plan does incorporate an ecologically based approach in many of the vision statements, desired future conditions, standards, and guidelines related to vegetation and associated wildlife habitat, both forestwide and in vegetation management areas. This includes direction to manage for vegetation that is healthy and provides quality habitat for associated species. There is direction to manage for general rangeland health and diversity. Forestwide direction in the sustainable forest and fire sections recognizes forests as recycling systems and the need to manage for the whole cycle, including for fire as a natural process.

Continued management under 1986 Forest Plan direction would result in a continued increase in late seral states, in those places where they are underrepresented, as young trees mature. However, many forested areas would remain overly dense, with trees competing for resources and susceptible to insect, disease, and drought induced mortality, and uncharacteristically high-severity wildfire. Lack of open canopy and competition from trees and shrubs would suppress grass production. The combination of high risk of high-severity fire and less grass cover has the potential to impact watershed function through concentrated and increased runoff, increased sedimentation, and increased erosion.

Environmental Consequences for Vegetation Common to Alternatives 2, 3, 4, and 5

Under all action alternatives, the revised plan includes specific plan components related to vegetation composition, structure, and function that would contribute to biodiversity and ecological integrity on the Carson NF. This direction provides substantially more detail and clarity than the 1986 Forest Plan as to specific vegetation conditions and processes to strive for. The direction is consistent with the natural range of variation and natural disturbances that, based on current knowledge, would maintain or trend ecosystems toward resilience and sustainability. Compared to alternative 1, action alternatives would result in more areas where vegetation composition, structure, and function are within the natural range of variation and maintain ecological integrity.

Action alternative direction includes quantitative and qualitative desired conditions for vegetation composition, structure, and function, generally and by individual vegetation community. There is direction to manage for attributes at an appropriate scale and according to the potential for a specific site's

environmental conditions. There is specific direction to restore the natural role of fire (FW-VEG-DC-2)¹, manage for old-growth attributes (FW-VEG-DC-4), promote herbaceous vegetation to protect soil and ecosystem function (FW-VEG-DC-9), and manage understory vegetation toward site potential (FW-VEG-DC-21). Collectively, the full suite of desired conditions would direct management to restore ecosystems that have been degraded by past management and to improve ecological integrity across vegetation communities.

All action alternatives recognize the additional uncertainties imposed by an uncertain and changing climate. They are designed around strategies that are responsive, including maintaining and restoring resilient native ecosystems and managing adaptively. Adaptive management is a framework within which land managers and partners work together to understand what is happening on the land and improve management based on changing conditions, new information, and monitoring. Though specific management techniques that will be successful in the future are not now fully understood, ecosystems would be more likely to maintain or trend toward resilience and sustainability if they are managed with changing climate conditions in mind.

The design of components in the revised plan facilitates reliable and repeatable monitoring of existing conditions and trends over time, and the monitoring plan reflects this. Measurable monitoring components are important for determining how management activities and ecological processes may be influencing vegetation conditions and the achievement of desired conditions over time.

Fuels and Wildland Fire Environmental Consequences

Environmental Consequences for Fuels and Wildland Fire Common to all Alternatives

The 1986 Forest Plan and all action alternatives recognize the key role that fire plays in maintaining vegetation diversity. Fire will be a disturbance in the future, even under alternative 3, where its extent is most limited. Under all alternatives, it would provide characteristic ecological functions in some places where it occurs, while in other areas it would burn with uncharacteristically high severity because of fuel accumulation, environmental conditions, or a combination of both and result in loss of canopy cover, disturbed habitat, and negative soil impacts (erosion, sterility, hydrophobicity).

Under warmer and drier climate conditions, the potential for wildfire would increase as fire seasons lengthen, vegetation water stress increases, and warmer temperatures become more common. An analysis of trends in wildfire and climate in the western United States from 1974 to 2004 shows a substantial increase in both the frequency of large wildfires and fire season length since 1985 (Westerling et al. 2006). These changes are closely linked with advances in the timing of spring snowmelt and increases in spring and summer air temperatures. Earlier spring snowmelt probably contributed to greater wildfire frequency in at least two ways—by extending the period during which ignitions could potentially occur and by reducing water availability to ecosystems in mid-summer before the arrival of the summer monsoons; thus, enhancing drying of vegetation and surface fuels (Westerling et al. 2006).

This trend of increased fire size corresponds with an increased cost for fire suppression during the same period. In recent years, areas of western forests have been increasingly impacted by wildfires, with suppression costs of more than \$1 billion per year from Federal land management agencies. Since about the mid-1970s, the total acreage of areas burned and the severity of wildfires in pine and mixed-conifer forests have increased (USDA FS 2010c). The summers of 2011 and 2012 saw the two largest wildfires in New Mexico state history, Las Conchas Fire and Whitewater-Baldy Complex, respectively (InciWeb 2015). If temperatures increase, precipitation decreases, and overall drought conditions become more

¹ Plan codes are used throughout this document to refer to specific plan sections or components. Plan direction referred to by plan codes can be found in the plan. See pages ix and x and chapter 1 of the plan for more information.

common, fire frequency and severity would likely be exacerbated. In addition, continued population growth and increasing national forest use will likely result in more human-caused fires.

Environmental Consequences for Fuels and Wildland Fire - Alternative 1

Alternative 1 provides direction to allow fire, as closely as possible, to function in its natural ecological role, which however, is not well-defined. The use of fire is encouraged while also protecting property and the safety of the public. There is a lack of vegetation community-specific desired conditions related to fire regimes and vegetation structure and composition. This would allow a wide range of fuels and fire management options that do not necessarily mimic natural fire regimes or restore desired ecosystem functions. There are no objectives related to fire or fuels treatment, and management practices would continue at current rates, resulting in fire on the landscape at levels far below the historic range. Related vegetation effects would continue, including fewer fire-created openings, suppressed understory response, less aspen regeneration, and an overabundance of fire-sensitive species such as white fir. Fires that burn in departed, overly dense frequent fire forests would be likely to include some uncharacteristically high severity and negative environmental impacts including soil damage, loss of large overstory trees, and habitat loss.

Environmental Consequences for Fuels and Wildland Fire Common to Alternatives 2, 3, 4, and 5

Under all action alternatives, vegetation communities would be closer to their desired structure and composition and fires would have more characteristic effects, particularly in frequent fire forests. Fire would be more common under all action alternatives than under alternative 1. More fire across the landscape would result in more fire-created openings, increased understory response, more aspen regeneration, better nutrient cycling, and a reduction in the overabundance of fire-sensitive species such as white fir.

Environmental Consequences for Fuels and Wildland Fire - Alternative 2

Fire would be desired in more locations than in alternative 3, where it is limited near trails and in suitable timber. Fire would be desired under more environmental conditions than in alternative 4, where mechanical preparation is limited, and ecological conditions are less likely to favor resource objectives. Therefore, alternative 2 would apply fire as a process, with associated ecological benefits, across more acres than any other alternative. Those ecological benefits include those listed above. For example, regenerative and nutrient cycling processes would be increased. Patch dynamics and stand structure would be closer to their historic range. Across the landscape, fire regimes would be closer to desired conditions than under any other alternative and ecological integrity would be highest.

Environmental Consequences for Fuels and Wildland Fire - Alternative 3

Fire would be infrequent in some areas including suitable timber and near trails where it would generally be suppressed according to FW-FIRE-G-1 (Draft Carson National Forest Plan). Outside those areas, it would be more frequent than under any other alternative, but in suitable timber and near trails the ecological benefits of fire would be less than under any other alternative. Those ecological benefits have been listed previously. For example, fuel loading and continuity would continue to be higher than desired in many areas that are either not treatable mechanically or had not yet been treated, and in large areas of frequent fire forests uncharacteristically severe wildfire would be likely. Among action alternatives, the role of fire as a process would be most dissimilar from the natural regime under this alternative, with the greatest negative impacts to ecological integrity. For example, uncharacteristically high fuel loading that favors uncharacteristically severe wildfire can result in loss of canopy cover and negative soil impacts (erosion, sterility, hydrophobicity). Planned prescribed fire may be implemented less than under other

alternatives as fire management cost savings would be needed to offset the increased recreational focus under this alternative.

Environmental Consequences for Fuels and Wildland Fire - Alternative 4

The small amount of mechanical treatment that would occur under alternative 4 would focus on treating fuels to protect communities and other wildland-urban interface areas, but fires would often burn with uncharacteristic intensities in many untreated Frequent Fire Forest areas. In those forests, fire effects would be more likely to result in loss of canopy cover and negative soil impacts (erosion, sterility, hydrophobicity) than under alternative 2. In other forest and woodland types, fire management and effects would be similar to those under alternative 2.

Environmental Consequences for Fuels and Wildland Fire - Alternative 5

Alternative 5 adds 57,314 acres of recommended wilderness to alternative 2. Much of that additional acreage (23,202 acres) is in High-Elevation Forest systems and wilderness recommendation would have little effect on fire management or effects. There are 11,839 additional acres in Frequent Fire Forest, 9,452 additional acres in Grassland, and 10,603 additional acres in woodland systems where wilderness would change fire management and subsequent wildfire effects significantly. Particularly in the frequent-fire forests, lack of treatment would mean that fuels would remain dense and continuous, and wildfires would be more likely to burn with uncharacteristically high severity, resulting in loss of canopy cover, conversion to other cover types (shrubs or grass), overrepresentation of early seral states, and soil impacts such as increased erosion, soil sterility, or hydrophobicity. Outside of additional recommended wilderness areas, effects would be similar to alternative 2.

Environmental Consequences for Alpine and Tundra

Environmental Consequences for Alpine and Tundra Common to all Alternatives

With warmer temperatures, reduced snowpack, and a lengthening growing season, trees and shrubs are likely to move upslope under all alternatives, invading alpine and tundra areas. The extent of alpine and tundra would likely contract as it is pressured by uncharacteristic, treed seral states from lower elevations. Ecological integrity of alpine and tundra would be vulnerable as structure, species composition, and disturbance processes respond to climatic changes, particularly at lower elevations in the vegetation community.

At least 86 percent of alpine and tundra would be contained in designated or recommended wilderness under all alternatives. Alternative 5 would include the most additional acres in recommended wilderness (954 acres, or about 9.5 percent). Most alpine and tundra that could be included in recommended wilderness areas is currently inside inventoried roadless areas and sees little management or public use. There would be no significant management impacts to alpine and tundra areas under any alternative. Primitive, non-motorized recreation would be the main use under all alternatives, and it is likely to increase in the future. Concentrated recreation could have localized impacts in some areas, reducing herbaceous ground cover and increasing the potential for erosion, but overall, impacts are not likely to be significant on the landscape. Species composition and patch size are slightly departed but would not be directly addressed under any alternative and would likely remain slightly departed. Insects and diseases are not a significant characteristic of this system and are not expected to become one under any alternative. Fire is very rare and is expected to remain very rare under all alternatives. Fire regime condition class is expected to remain mainly in class I.

Environmental Consequences for High-Elevation Forests

Discussion of modeling results and evaluation criteria

In general, there are few open roads in high-elevation forests, but legacy (closed) roads are common. While some closed roads have revegetated, and their effects are minimal, many still impact habitat, watershed function, and attract illegal motorized use.

Table 17. Road density (miles per square mile) in high-elevation forest communities

Category	Bristlecone Pine	Spruce-Fir Forest	Mixed Conifer with Aspen
Open roads	1.19	0.40	0.59
All roads*	2.20	2.59	2.36

*All roads include open roads and closed, or non-system, user-created roads.

Snags and coarse woody debris were estimated in spruce-fir forest and mixed conifer with aspen by applying average coefficients by seral state to modeled seral state proportions. Snags are modeled in two size classes—all snags larger than 8 inches and all snags larger than 18 inches. Snags and coarse woody debris were modeled by applying average per-acre values to seral state proportions for current conditions and year 15 seral state predictions. The modeled change is the percent difference between those two. The current number of snags and volume of coarse woody debris are actual measured values that may differ from the modeled current condition based on seral state proportions.

Table 18. Snags larger than 8 inches in the spruce-fir forest and mixed conifer with aspen vegetation communities

Vegetation Community	Current	Desired	Departure	Modeled Change	Trend
Spruce-Fir Forest	9.0	13–30	underrepresented	96%	stable*
Mixed Conifer with Aspen	13.1	20	underrepresented	106%	slightly toward desired range

*Spruce beetle is currently causing mortality on the Rio Grande National Forest. It is probable that this will also occur on the Carson National Forest in the future and snags will trend toward their desired range.

Table 19. Snags larger than 18 inches in the spruce-fir forest and mixed conifer with aspen vegetation communities

Vegetation Community	Current	Desired	Departure	Modeled Change	Trend
Spruce-Fir Forest	2.6	1–3	similar	128%	increasing within desired range*
Mixed Conifer with Aspen	2.3	1–5	similar	137%	increasing within desired range

*Spruce beetle is currently causing mortality on the Rio Grande National Forest. It is probable that this will also occur on the Carson National Forest in the future and snags will exceed their desired range.

Table 20. Coarse woody debris (USDA FS 2014a, downed wood larger than 3 inches) in the spruce-fir forest and mixed conifer with aspen vegetation communities

Vegetation Community	Current (tons/acre)	Desired (tons/acre)	Departure	Modeled Change	Trend
Spruce-Fir Forest	17.4	5–40	similar	105%	stable
Mixed Conifer with Aspen	10.4	5–40	similar	110%	increasing within desired range

Table 21. Acres of high-elevation forest recommended for wilderness under each alternative and the percentage of total high-elevation forests on the Carson that those acres represent

Category	High-Elevation Forest (acres)	High-Elevation Forest (percentage)
Total High-Elevation Forest	425,473	100
Current Designated Wilderness	98,474	23
Alternative 1 Recommended Wilderness	0	0
Alternative 2 Recommended Wilderness	5,880	1
Alternative 3 Recommended Wilderness	0	0
Alternative 4 Recommended Wilderness	19,300	5
Alternative 5 Recommended Wilderness	29,082	7

Environmental Consequences for High-Elevation Forests Common to All Alternatives

High-elevation forests are moderately to highly vulnerable to climate change, though the specific expression of or interaction among impacts is uncertain (USDA FS 2014a). Warmer temperatures, more variable precipitation, and increased moisture deficit are likely to stress vegetation, and make high-elevation forests more vulnerable to fire, insects, and disease. Fires would likely be more frequent and widespread, though warming temperatures may increase precipitation at high elevations, in which case the fire regime could change little. Fire regime condition class is likely to remain mostly in class II. Insects such as western spruce budworm and spruce beetle are likely to proliferate in stressed and weakened trees and mortality is likely to increase. However, past spruce budworm outbreaks have been associated with periods of increased moisture (Ryerson et al. 2003), and warmer, more drought-prone conditions could reduce budworm activity and temper severity of future outbreaks. Root rot is likely to increase in stressed forests. White pine blister rust is not currently present on the Carson but is likely to spread across the entire range of bristlecone pine in the future (Tomback et al. 2011).

Snags and coarse woody debris would increase toward desired conditions, except for small snags in Spruce-Fir Forest, which would remain stable but underrepresented. Seral state distribution would trend toward the desired condition under all alternatives as overrepresented, medium age classes grow into large, old age classes. Species composition is slightly to moderately departed mostly due to overrepresentation of aspen in spruce-fir forest and Kentucky bluegrass in mixed conifer with aspen. That departure is likely to continue, particularly if insect and disease outbreaks cause increased mortality in the future. Patch size is larger at lower elevations, mostly due to fire exclusion and past timber harvesting. Some alternatives promote additional fires below high-elevation forests that may spread and increase fire frequency in high-elevation forests, resulting in smaller average patch size. On the other hand, fire frequency is regulated by late-melting snowpack and frequent summer rains, both of which may be altered by climate change, increasing the risk of more frequent stand-replacing fire and the potential for large early seral patches. Spruce budworm activity is likely to decrease, root rot is likely to increase, and white pine blister rust may cause widespread mortality. It is difficult to predict exactly how those interacting disturbances will manifest in terms of patch size, and the uncertainty is similar under all alternatives.

Environmental Consequences for High-Elevation Forests—Alternative 1

There are high existing closed and non-system road densities in all high-elevation forest types. Alternative 1 limits the density of roads that may be constructed but does not limit existing road density or include specific direction to remove or rehabilitate any roads. Some obliteration or naturalization of unneeded roads would occur as opportunities arise, but road building with densities of up to 4.0 miles per square mile are specifically allowed. Generally, many road-related impacts would continue, including concentration of surface flows, increased sedimentation, and habitat loss and dissection. Vegetative

ground cover would continue to be slightly lower than desired mainly due to human disturbance (roads and concentrated recreation). Management response to insect and disease outbreaks could occur in many forms but would not necessarily improve ecological integrity or move these systems toward desired conditions.

Environmental Consequences for High-Elevation Forests Common to Alternatives 2, 3, 4, and 5

All action alternatives incorporate concepts of adaptive planning and monitoring. The monitoring plan is capable of detecting change, with an adaptive flexibility to respond to detected changes. The monitoring program is designed around key management questions and identifies measurable indicators to inform those questions. The more flexible plan under alternatives 2, 3, 4 and 5 would allow the Carson to adapt its management to changing conditions and improve management based on new information. In high-elevation forests particularly, an adaptive management approach would allow more effective response to uncertain future stressors. The vegetation community-specific desired conditions define characteristics that would maintain functional forest systems and set the course that adaptive management would endeavor to follow. These include desired distribution among seral states, aspen condition and distribution, fire regimes, and spatial arrangement. Ecological integrity would be better maintained compared to the very limited direction provided under the 1986 Forest Plan (alternative 1).

Environmental Consequences for High-Elevation Forests—Alternative 2

Alternative 2 identifies 5,880 acres for recommended wilderness. All but 10 of those acres are already in inventoried roadless areas or are included in the Valle Vidal Management Area under alternative 2. There would be very little difference in vegetation management or user impacts compared to alternative 1.

Alternative 2 includes requirements to emphasize road reconstruction and rehabilitation over new road construction (FW-TFA-1), and to offset any resource damage resulting from new road construction through mitigating actions (FW-TFA-G-2). In addition, alternative 2 includes the San Antonio and Valle Vidal Management Areas, which each contain significant amounts of high-elevation forests. They both limit development and road construction. Existing closed and non-system roads would continue to naturalize and would have diminishing watershed and habitat impacts such as sedimentation and habitat dissection. There is an objective to obliterate or naturalize unneeded roads (FW-TFA-O-1) and a standard that prohibits motor vehicle use off the designated system of roads, trails, and areas (FW-TFA-S-1). However, illegal use is likely to occur on routes that are not obliterated or naturalized, with its accompanying spread of invasive species, human-caused fire, and resource damage.

Environmental Consequences for High-Elevation Forests—Alternative 3

Alternative 3 does not recommend any new areas for wilderness and does not include any restrictions in the San Antonio or Valle Vidal Management Areas. The conversion of project roads to system roads or trails is encouraged (FW-TFA-G-3). There is no requirement to offset road construction with mitigating actions (FW-TFA-G-1), and there is no objective to obliterate unneeded roads. Under this alternative, there would likely be motorized use in more places on the Carson, including illegal use on closed but drivable roads. This would have direct impacts through understory vegetation removal, and indirect impacts through additional invasive species spread, human-caused fire, and resource damage.

Some additional timber harvest may occur in high-elevation forests, though it is not a specific objective. Mechanical treatment would continue to be rare, as it is in alternative 1. Fire would be suppressed in many locations where lands are suitable for timber production or where it would impact trail access (FW-FIRE-G-1). Less fire would result in less aspen regeneration and less nutrient cycling. The recently burned early seral state in spruce-fir forest would remain underrepresented. With fire suppressed and increased impacts from motorized use, ecological integrity would be most degraded under this alternative.

Environmental Consequences for High-Elevation Forests—Alternative 4

Alternative 4 recommends additional areas for wilderness that are outside of inventoried roadless areas (19,300 acres total). It also adds a restriction on the number of acres that may be treated in any one year in the San Antonio Management Area. Those acres would likely be applied to restoring fire in frequent fire forests and protecting wildland-urban interface areas, meaning that little treatment would likely occur in the high-elevation forests in that management area. Large areas of high-elevation forests would be removed from the suitable timber base in the San Antonio and Valle Vidal Management Areas. None of this management direction would be very dissimilar from recent management (effects would be similar to alternative 1), but it would limit treatment options if insect and disease outbreaks were to worsen in the future.

The miles of obliterated or naturalized roads would double under alternative 4 (FW-TFA-O-1), but initially these miles would all occur in the Wetland Jewel Management Area (MA-WJMA-O-4). While 44,113 acres, or 55 percent, of the Wetland Jewel Management Area is within high-elevation forests, that equals only 10 percent of all high-elevation forests on the Carson NF. In addition, over half of the high-elevation forests in the Wetland Jewel Management Area are in designated wilderness or are recommended for wilderness in alternative 4 and have no roads to obliterate. Therefore, more miles of roads would be obliterated or naturalized, but likely those additional miles would not be in high-elevation forest vegetation communities. The impacts of remaining roads in high-elevation forests would likely be similar to alternative 1.

Overall, ecological integrity would not be improved over alternative 2 and could potentially be lower, depending on what management responses are required to address future insect and disease outbreaks.

Environmental Consequences for High-Elevation Forests—Alternative 5

Alternative 5 recommends 29,082 acres of high-elevation forests for wilderness, 23,202 acres more than alternative 2. Management of these areas would likely be similar to current management, but alternative 5 would limit treatment options if insect and disease outbreaks were to worsen in the future, resulting in a higher level of uncertainty as to future vegetation conditions.

Environmental Consequences for Frequent Fire Forests

Discussion of modeling results and evaluation criteria

Mechanical and wildland fire (both planned and naturally caused unplanned) acres differ by alternative based on objectives for ponderosa pine forest and mixed conifer with frequent fire. There are additional acres of wildfire (unplanned human-caused) that are not included here but were modeled in consistent amounts across alternatives. After 15 years, varying levels of treatment result in different modeled seral state departure values. The least total treatment occurs in alternative 1 and results in the highest departure. Alternative 3 results in the lowest seral state departure by year 15 (table 22 and table 23).

Table 22. Annual treatments in ponderosa pine forest under each alternative and resulting seral state departure at year 15

Alternative	Mechanical Treatment (acres)	Wildland Fire Treatment (acres)	Seral State Departure
1	1,194	1,234	82
2	3,600	10,250	59
3	7,500	10,250	41
4	582	13,750	71
5	3,600	10,250	59

Table 23. Annual treatments in mixed conifer with frequent fire vegetation community under each alternative and resulting seral state departure at year 15

Alternative	Mechanical Treatment (acres)	Wildland Fire Treatment(acres)	Seral State Departure
1	466	115	54
2	775	3,000	43
3	2,250	3,000	33
4	350	3,750	44
5	775	3,000	43

Modeled seral state departure was also tracked beyond the life of the plan (out to year 50) to demonstrate the trend by alternative. Departure under the current 1986 Forest Plan remains high. Departure improves most rapidly under alternative 3, but all action alternatives reach similar levels of departure by year 50 (figure 2 and figure 3).

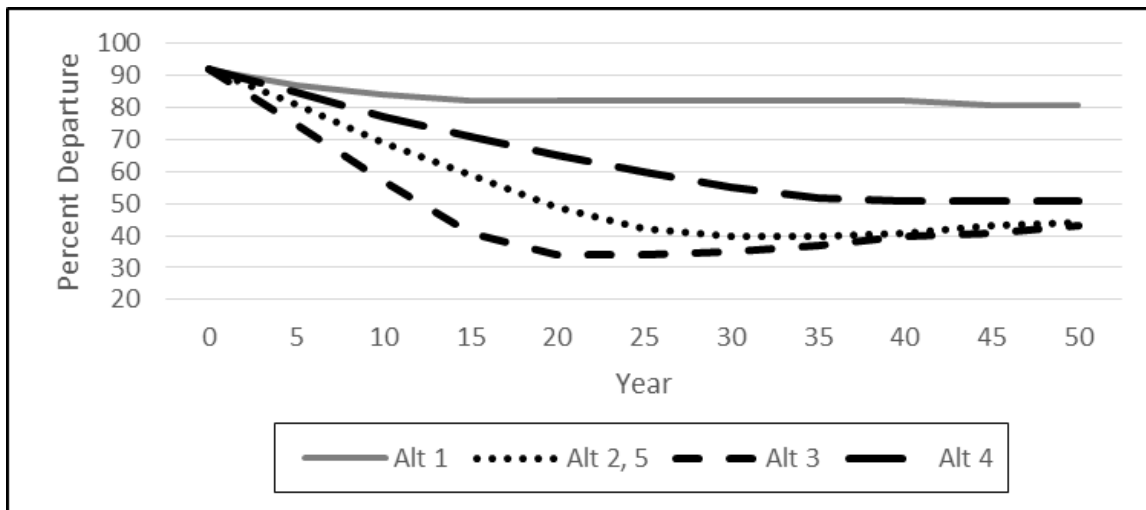


Figure 2. Ponderosa pine forest seral state departure by alternative through year 50

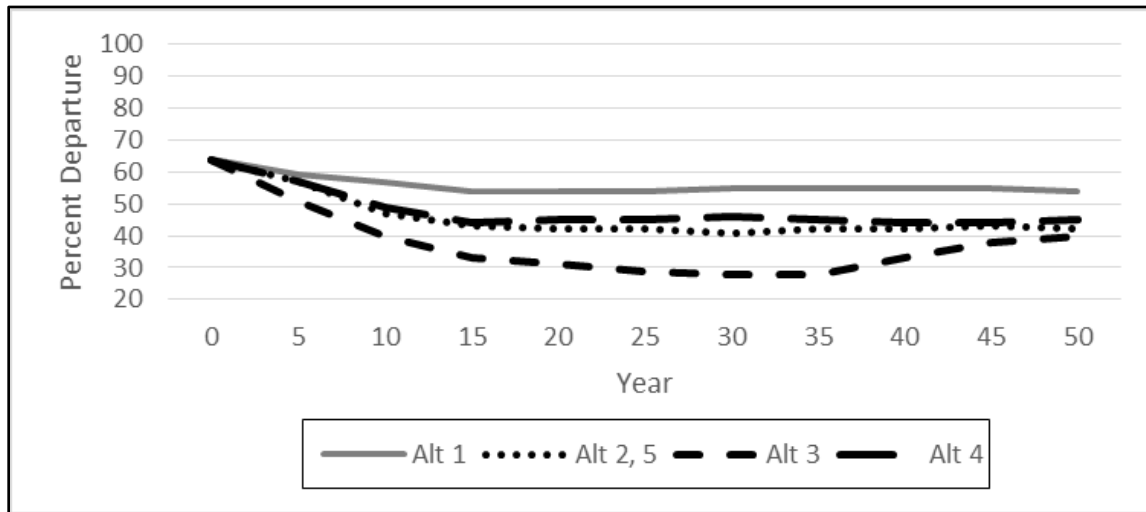


Figure 3. Mixed conifer – frequent fire seral state departure by alternative through year 50

Closed canopy states are uncharacteristic in ponderosa pine forest and should represent a minority (28 percent) of mixed conifer with frequent fire. Overrepresentation of closed-canopy states, as currently exists, indicates an increased risk for high-severity fire and bark beetle or mistletoe outbreaks and reduced herbaceous cover in the shaded understory. By year 15, there would be fewer acres with closed canopy under any of the action alternatives compared to the current plan. Alternative 3 would result in the fewest acres of closed canopy in frequent fire forests and is closest to desired conditions (table 24).

Table 24. Closed canopy in frequent fire forests (ponderosa pine forest and mixed conifer with frequent fire) by alternative

Alternative	Closed Canopy States in Frequent Fire Forests (acres)
Desired*	51,197
Current	382,119
Alternative 1, year 15	378,862
Alternative 2	242,994
Alternative 3	171,516
Alternative 4	253,681
Alternative 5	242,994

*Closed canopy is **desired as a seral state only in mixed conifer with frequent fire**, though it is common in both ponderosa pine forest and mixed conifer with frequent fire on the Carson currently.

Open canopy conditions with multiple stories are the desired seral state for the great majority of frequent fire forest acres. This condition supports the desired frequent, low-severity fire regime, and is most resistant to widespread bark beetle outbreaks. Open canopy improves the herbaceous understory and provides desired wildlife habitat. By year 15, there would be more acres in multistoried, open states under any of the action alternatives than under alternative 1. Alternative 3 would create the most multistoried, open acres, though all alternatives would be deficient.

Table 25. Open canopy with multiple stories in both ponderosa pine forest and mixed conifer with frequent fire under each alternative

Alternative	Multistoried, Open States in Frequent Fire Forests (acres)
Desired*	410,092
Current	16,731
Alternative 1	57,701
Alternative 2	151,815
Alternative 3	223,293
Alternative 4	112,438
Alternative 5	151,815

*The desired condition is that the majority of mixed conifer with frequent fire and ponderosa pine forest is in a multistoried, open state. Currently, that condition is uncommon on the Carson.

The desired fire rotation interval is based on the historic range of years between fires at a given location. Fire rotation interval measures the number of years it would take for an area the size of the entire vegetation community to burn. Currently, and under alternative 1, the rotation interval is much more infrequent than desired. All action alternatives would result in rotation intervals much closer to the desired condition than alternative 1, though none of the alternatives achieves desired fire frequency in either Mixed Conifer with Frequent Fire or Ponderosa Pine Forest. Fire rotation interval estimates are averaged

forestwide, which is an unrealistically uniform distribution. In practice, fire is more likely and more desired in some locations over others. Therefore, those locations where fire is more concentrated may achieve the desired frequency under the action alternatives.

In figure 4, a shorter rotation interval indicates more frequent fire in the system. Action alternatives have objectives that define a range of acres burned, and therefore, the rotation interval is displayed as a range. The vertical axis in figure 4 is logarithmic.

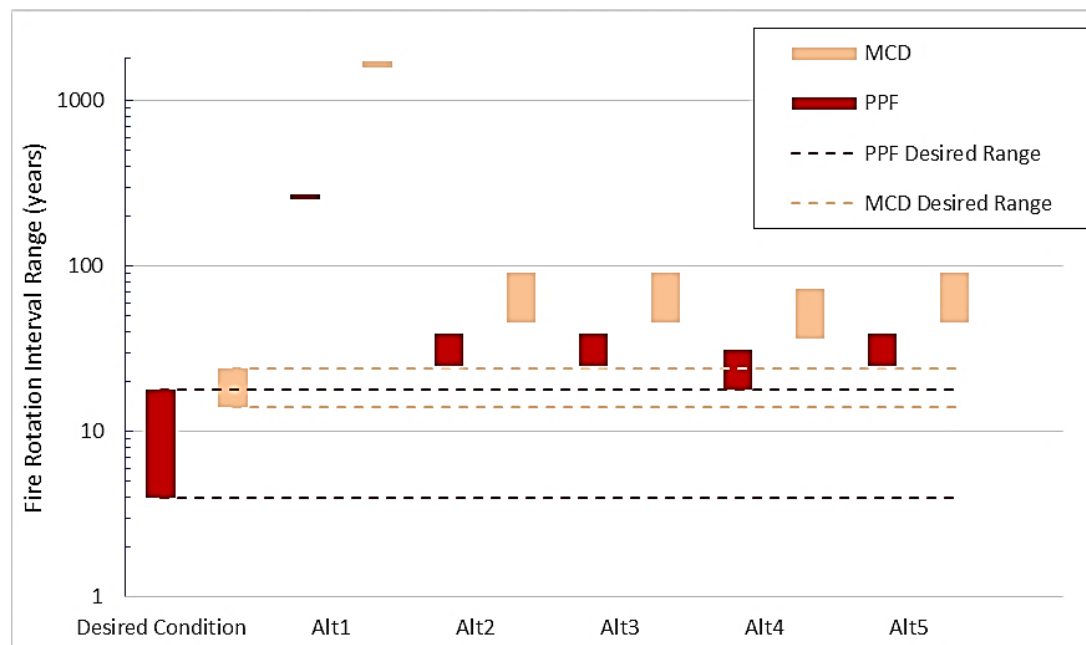


Figure 4. Fire rotation interval for ponderosa pine forest and mixed conifer with frequent fire by alternative

Environmental Consequences for Frequent Fire Forests—Alternative 1

Under the current 1986 Forest Plan, fire frequency would remain far below the desired rotation interval (fire regime condition class III). Mechanical treatment would not sufficiently alter stand structures or species composition to make up for the lack of fire. As a result, forests would remain dense with the most closed states and fewest uneven-aged, open states of any alternative. Forests in this condition are less productive because there is more competition for resources. Trees would be less resilient to drought, insects, disease, and changing climate. Fire-sensitive species such as white fir would continue to be overrepresented. Dense forests with unbroken fuels are more likely to burn with uncharacteristic severities that kill the majority of trees, including those in the overstory (active crown fire), and cause uncharacteristic soil damage such as hydrophobic soils and loss of soil function. Patch size would remain higher than desired and forests would be more susceptible to widespread insect and disease mortality.

Less representation in open canopy states suppresses understory production, which reduces available forage, soil stability, and nutrient cycling. Lower abundance and diversity of understory species has negative habitat impacts and is less likely to carry low-intensity fire.

While large, uncharacteristically high-severity fires may be followed by a substantial aspen response over large areas, that condition is not desired in frequent fire forests. Aspen is desired as a minor inclusion that is well-distributed, not as a seral state in large patches, which would be likely under this alternative. This alters habitat distribution, fire regimes, and reduces the available conifer seed source.

The number of small and large snags would trend toward desired levels except for large snags in Ponderosa Pine Forest, which are overrepresented currently and would continue to increase in number

due to overstocked forests and a lack of fire to remove dead trees. Coarse woody debris in Ponderosa Pine Forest is currently just below the desired level and would increase very slightly. Coarse woody debris would decrease slightly in Mixed Conifer with Frequent Fire, away from desired conditions, as some stands move from closed to open states. There is no direction in the current 1986 Forest Plan to move toward desired levels of snags or coarse woody debris. There would be sufficient snags and coarse woody debris from a habitat perspective, but overabundance would contribute to an elevated risk of uncharacteristically high-severity fire.

Environmental Consequences for Frequent Fire Forests Common to Alternatives 2, 3, 4, and 5

Fire is encouraged and much more common in all action alternatives. Fire rotation intervals would be much closer to the desired frequency than they would under alternative 1 and fire regime condition class would be reduced. This would have multiple environmental benefits, including increased nutrient cycling, a more diverse and abundant understory, and a more open, uneven-aged stand structure. Openings in the canopy break up continuous fuels and promote lower intensity fire behavior, which would reduce the risk for uncharacteristic high-severity fire and large openings that may not regenerate naturally. Average patch size would be smaller, moving toward desired condition and tempering insect and disease spread. Fuel conditions that support a more low-severity fire regime would allow fire to be managed to provide ecological benefits more often and in more places.

Ecological integrity is higher in stands with the uneven-aged, multistoried, open structure and frequent characteristic disturbance processes that would be more common in the action alternatives. Stands in that condition would be more able to resist insects, disease, fire, drought, and changing climate and more adaptable as stressors change.

Large, old trees would be maintained under all action alternatives, though to varying degrees due to different levels of mortality from fire. Modeling predicts that all action alternatives would result in less coarse woody debris, and would move away from desired conditions as dense, closed states become more open. However, all action alternatives would require management of coarse woody debris toward specific desired levels in frequent fire forests (FW-VEG-PPF-DC-7, FW-VEG-MCD-DC-5) which would better provide for at-risk species habitat than alternative 1. The number of snags would move toward desired conditions, except for large snags in Ponderosa Pine Forest, which are currently overrepresented and would continue to increase under all alternatives. All action alternatives have desired conditions which guide management and define desired levels of coarse woody debris and snags. Separate actions that would manage toward those desired conditions were not modeled but would occur under action alternatives (FW-VEG-G-1) and would improve coarse woody debris and snag distribution compared to alternative 1.

Environmental Consequences for Frequent Fire Forests - Alternative 2

The combination of mechanical manipulation of vegetation structure followed by fire favors more natural and desirable processes compared to mechanical or fire treatment alone. When vegetation structure that supports low intensity, fire is first restored mechanically, a variety of tree size classes are more likely to survive fire, uncharacteristic soil impacts are less likely, and wildfires are more manageable. At year 15, seral state departure under alternative 2 would be lower than under the current 1986 Forest Plan, but higher than under alternative 3, though by year 50 all action alternatives would have similar departures. Closed states and uneven-aged, open states would trend toward desired conditions, though not as quickly as under alternative 3.

Increased levels of mechanical vegetation treatment compared to alternative 1 would cause increased ground disturbance and associated negative effects to understory vegetation (crushing, removal). There may be localized, short-term impacts to soil stability and erodibility, with subsequent watershed impacts such as increased sedimentation. There may be higher probability of localized invasive species

distribution and establishment in disturbed areas. However, overall soil and watershed condition would be improved by restoring more natural disturbance regimes, vegetation structure, and hydrologic function.

Due to the widespread application of low-severity fire, fuel loading and continuity and the resultant threat of uncharacteristic wildfire would all be reduced. Less uncharacteristically high-severity wildfire would mean less overstory canopy loss, more desirable forest structure and patch size, less erosion potential, and less post-fire flooding and sedimentation. Regenerative and nutrient cycling processes would be increased.

Aspen abundance and distribution would be closer to desired conditions than under any other alternative because low intensity fire would promote the desired patch size and heterogeneity, but uncharacteristic, high-severity fire would not create opportunities for large expanses of pure aspen.

Overall ecological integrity would be highest under alternative 2 because, while structurally this alternative lags behind alternative 3 until year 50, fire is a component in more Frequent Fire Forest areas across the landscape.

Environmental Consequences for Frequent Fire Forests - Alternative 3

Alternative 3 would be the most effective at quickly moving toward structural and species composition desired conditions. This would have benefits in terms of resistance and resilience to disturbances such as insects, disease, and fire. By year 15, there would be fewer areas in a closed canopy state and more in a multistoried, open state than under any other alternative.

Widespread mechanical vegetation treatment under alternative 3 would result in the most ground disturbance and associated effects to understory vegetation. Localized, short-term impacts to soil stability and erodibility, with subsequent watershed impacts such as increased sedimentation would be more likely. There may be higher probability of localized invasive species distribution and establishment in disturbed areas. In treated areas soil and watershed condition would be protected by restoring more desirable vegetation structure and hydrologic function and reducing the risk of uncharacteristically high-severity wildfire, though untreated areas would remain at risk.

Fire would be infrequent in some areas including suitable timber and near trails where it would generally be suppressed according to FW-FIRE-G-1. Outside those areas it would be more frequent than under any other alternative and would be the only circumstance under any alternative where the desired frequency for fire would be met. However, in those areas where fires would not be desired (over 70 percent of mixed conifer with frequent fire and over 30 percent of ponderosa pine forest) the ecological benefits of fire would be less than under alternative 1. Not all of these areas without fire could be mechanically treated. Fuels would build up, particularly fire sensitive species such as white fir, leading to a high risk of uncharacteristic wildfire, more difficult fire management, and fire intensities and severities that would be higher than desired. There would be a higher risk for overstory canopy loss, greater erosion, soil sterility, and more post-fire flooding and sedimentation. The potential for additional roads and motorized access under alternative 3 would also increase the risk for human-caused fires.

Environmental Consequences for Frequent Fire Forests - Alternative 4

Alternative 4 would be the least effective action alternative for achieving structural or species composition desired conditions by year 15, though seral state departure remains only slightly more departed by year 50. Forest density would remain high, creating high risk for insect, disease, and uncharacteristic fire.

The small amount of mechanical treatment that would occur would focus on treating fuels to protect communities, but everywhere else fire management would be difficult and costly as fires would burn with uncharacteristic intensities in many areas. Fire effects would be more likely to result in loss of canopy

cover, greater erosion potential, soil sterility, and more post-fire flooding and sedimentation than under alternative 2.

In the San Antonio Management Area, vegetation management would be allowed on no more than 3 percent of the area in any year. If the majority of that treatment occurred as fire in frequent fire forests each year, the desired fire rotation interval could be achieved. Some mechanical wildland-urban interface fuels treatments could also be accomplished under that annual limitation. However, as in other areas under this alternative, effects from fire treatment alone would be more likely to have negative effects from uncharacteristic intensities.

Ground-disturbing impacts and associated effects to understory vegetation (damage, removal) would be less than under any other alternative due to a lack of mechanical treatment and road rehabilitation requirements (FW-TFA-S-3, 4). Localized, short-term impacts to soil stability and erodibility, with subsequent watershed impacts such as increased sedimentation would be least likely under alternative 4. There would be a lower probability of localized invasive species distribution and establishment in disturbed areas. Most areas would be untreated and would remain at risk from uncharacteristically high-severity wildfire, which has the potential to remove all understory vegetation, sterilize soils, or result in soil loss.

Under alternative 4 through year 50, frequent fire forests would be less resistant and resilient to disturbance compared to other action alternatives. They would more likely be negatively impacted by insects, disease, or fires that would further reduce their ecological integrity below what has been modeled.

Environmental Consequences for Frequent Fire Forests - Alternative 5

Effects of alternative 5 would be very similar to those of alternative 2. The additional 11,839 acres of frequent fire forests that would be recommended for wilderness constitute less than 2.4 percent of the total for the vegetation system and would not have a significant impact on overall vegetative conditions or fire regimes, except in localized areas. Frequent fire forests that are recommended for wilderness would not be mechanically treated and would be likely to burn with uncharacteristically high severities. Loss of canopy, increased runoff, soil sterility and loss, and increased sedimentation would be more likely.

Environmental Consequences for Aspen

Aspen is quantifiable as a seral state in spruce-fir forest and mixed conifer with aspen. The modeled seral state distribution in both of those vegetation communities is the same for all alternatives since treatment levels in those vegetation communities do not differ among alternatives. The desired number of acres and the modeled number of acres in the aspen state in each community during the first 50 years is shown in figure 5. The amount of aspen remains relatively stable. The figure shows that in spruce-fir forest, aspen is overrepresented and is predicted to remain so, and that in mixed conifer with aspen, aspen is underrepresented and is also predicted to remain so.

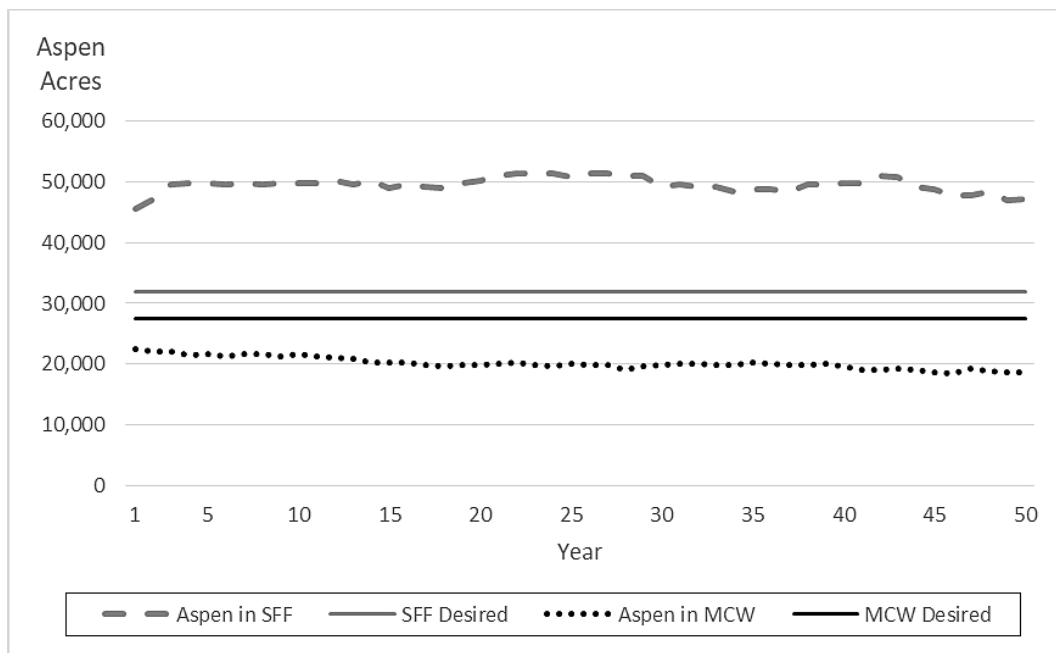


Figure 5. Acres of aspen seral states through year 50 in spruce-fir forest (SFF) and mixed conifer with aspen (MCW)

Environmental Consequences for Aspen Common to All Alternatives

Under all alternatives, modeling of high-elevation forests predicts that aspen representation would remain relatively stable. It would continue to be slightly overrepresented in spruce-fir forest and slightly underrepresented in mixed conifer with aspen. However, the effects of climate change were not modeled, and related insect, disease, fire, and drought impacts could have multiple, interrelated effects that are difficult to predict. Competition from stressed conifers may be reduced but aspen trees are also likely to experience additional stresses from the same sources. These uncertainties that would affect species composition and insect and disease outbreaks are similar across all alternatives.

Environmental Consequences for Aspen—Alternative 1

At the lower elevations of aspen’s range, in mixed conifer with aspen, mixed conifer with frequent fire, and ponderosa pine forest, current low levels of treatment and characteristic fire would continue, and regeneration, abundance, and distribution would likely continue to decline, remaining departed from forestwide desired conditions. Large, uncharacteristic, stand-replacing fire would be more likely with the lower treatment levels in frequent fire forests under alternative 1 and some of these areas that are wetter may respond through aspen regeneration. There may be additional opportunities for aspen regeneration, but stressors would also be likely to increase. Therefore, there is significant uncertainty in terms of the resulting patch size.

Under the combined influence of lack of fire disturbance, warmer and drier temperatures, insects, disease, and ungulate browsing, aspen ecological integrity would continue to decline.

Environmental Consequences for Aspen - Alternative 2

Alternative 2 would apply characteristic fire as a process across more acres than any other alternative. As a result, aspen abundance and distribution would be closer to desired conditions than under any other alternative, resulting in patch sizes that would also be closer to desired conditions. In frequent fire forests, low-intensity fire would promote the desired patch size and heterogeneity, but uncharacteristic, high-

severity fire would not create opportunities for uncharacteristic large expanses of pure aspen. Aspen condition in high-elevation forests would be similar to other alternatives, except that more specific desired conditions describing its abundance and distribution and an adaptive management approach would be more flexible in responding to insect outbreaks or other disturbances as compared to alternative 1.

Environmental Consequences for Aspen - Alternative 3

In mechanically treated frequent fire forests where structure is restored, aspen presence and distribution may be close to desired conditions, but probably less similar than if it were stimulated by fire. Patch size in these areas would be close to desired conditions. However, most frequent fire forests would not be mechanically treated and in untreated areas, aspen would likely be underrepresented. In burned areas it would occur in concentrated, uncharacteristic patches where it repopulated high-severity burns. Aspen condition in high-elevation forests would be similar to other alternatives. Specific desired conditions and adaptive management would improve ecological integrity in high-elevation forests compared to alternative 1.

Environmental Consequences for Aspen - Alternative 4

Due to the increased amount of fire on the landscape, aspen would likely be most common in this alternative, though its distribution in frequent fire forests would be more clumped than is characteristic. Patch sizes would likely be higher than desired. High-severity fire would be more likely in frequent fire forests and aspen would have additional opportunity to establish. In high-elevation forests, aspen may benefit if unmanaged insect outbreaks cause widespread conifer mortality, but aspen may be more susceptible to unmanaged insect and disease compared to alternatives 2, 3, and 5.

Environmental Consequences for Aspen - Alternative 5

Alternative 5 would recommend an additional 11,839 acres (2.4 percent) of frequent fire forests and an additional 23,202 acres (5.5 percent) of high-elevation forests for wilderness compared to alternative 2. In the untreated frequent fire forests, wildfires would be more likely to burn with uncharacteristically high severity and aspen may occur in concentrated, uncharacteristic patches where it repopulated those cleared areas. Overall, there would be slightly more aspen than in alternative 2, but less than in alternative 4. On the landscape there would not be a significant difference in overall ecological integrity compared to alternative 2.

Environmental Consequences for Woodlands

Discussion of modeling results and evaluation criteria

Modeled treatment levels in woodland communities do not differ among alternatives. All alternatives except alternative 4 would maintain some areas with woodland potential as grasslands. Instead this would lower the seral state departure for those areas managed for woodland desired conditions where the open, grass state is currently represented. Otherwise, all alternatives trend toward lower departure as the proportion of underrepresented late-seral, closed states increases.

Environmental Consequences for Woodlands Common to All Alternatives

Under all alternatives seral state departure would decline as trees fill in open canopies and create more late-seral, closed states. Closed states are likely to have less herbaceous ground cover than open states. However, coarse woody debris is predicted to increase under all alternatives, which would improve soil condition by slowing erosion and maintaining soil moisture. Patch size may increase, though desired conditions can still be met with some increase. Fire regime is not expected to be impacted significantly under any alternative, and fire regime condition class would likely remain in condition classes I or II.

Differences among alternatives regarding roads and road obliteration and naturalization would have little impact on management in woodlands, because woodland systems would not be a high priority for road removal. Road obliteration is less effective in the dry, flat settings where woodlands dominate. Often revegetation is less successful than in wetter locations, and illegal use is likely to continue adjacent to closed roads.

The predicted effects of climate change are expected to substantially change forest insect and disease dynamics (USDA FS 2012a). Even if normal precipitation levels in the Southwest continue, warmer temperatures alone could lead to tree mortality from moisture deficits as a result of increased evapotranspiration (Adams et al. 2009). Periods of drought or even average precipitation levels, exacerbated by higher temperatures and high stand densities, could contribute to future widespread beetle outbreaks and tree mortality, particularly in piñon-juniper woodland (USDA FS 2012a).

Environmental Consequences for Woodlands Common to Alternatives 2, 3, 4, and 5

All action alternatives provide more detailed descriptions of those conditions that would promote ecological integrity. Soil condition and understory herbaceous cover would be improved. There are plan components that direct management to maintain site appropriate levels of understory vegetative cover, which would improve soil function, moisture retention, and nutrient cycling (FW-PJO-DC-5, FW-PJS-DC-5, FW-SL-DC-1, -3, FW-WSW-DC-6, FW-GRZ-DC-5, FW-GRZ-S-1, FW-GRZ-G-1). There are plan components that define a desired amount of coarse woody debris to provide habitat and maintain soil productivity (FW-PJO-DC-8, FW-PJS-DC-8, FW-SL-DC-2). The presence of biological soil crusts is desired to improve nutrient cycling and stabilize soils (FW-PJO-DC-4, FW-PJS-DC-4, FW-SL-DC-4). Seral state and tree density would be managed according to specifically defined desired conditions to improve overall ecological integrity.

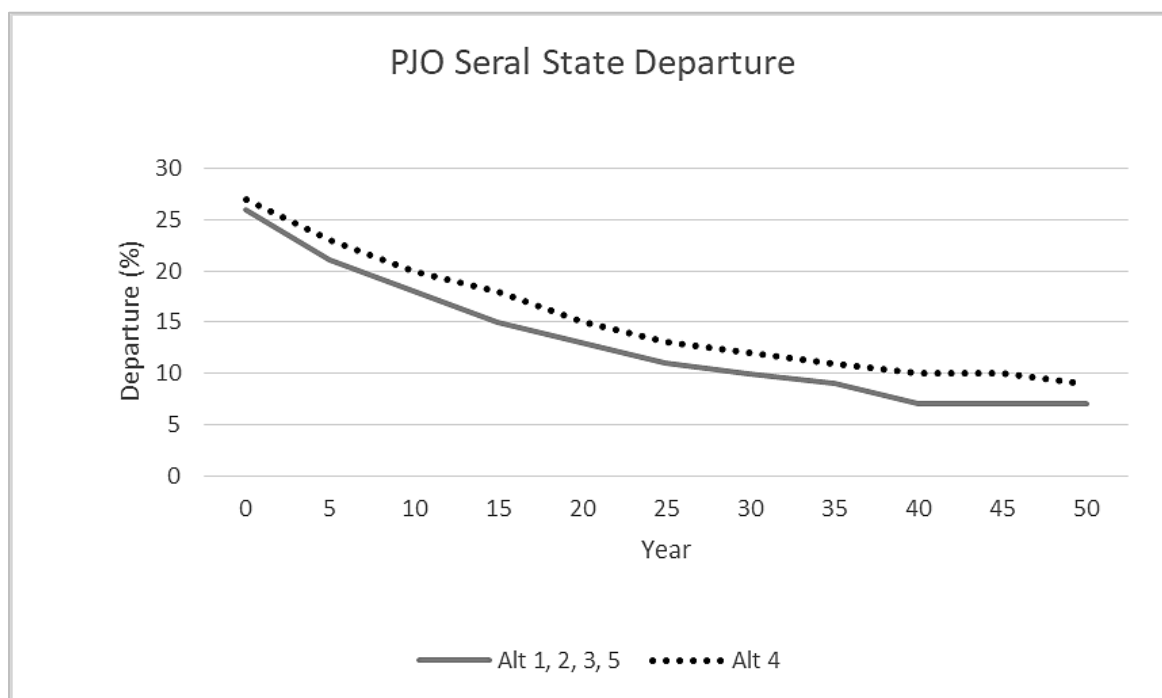


Figure 6. Piñon-juniper woodland (PJO) seral state departure by alternative through year 50

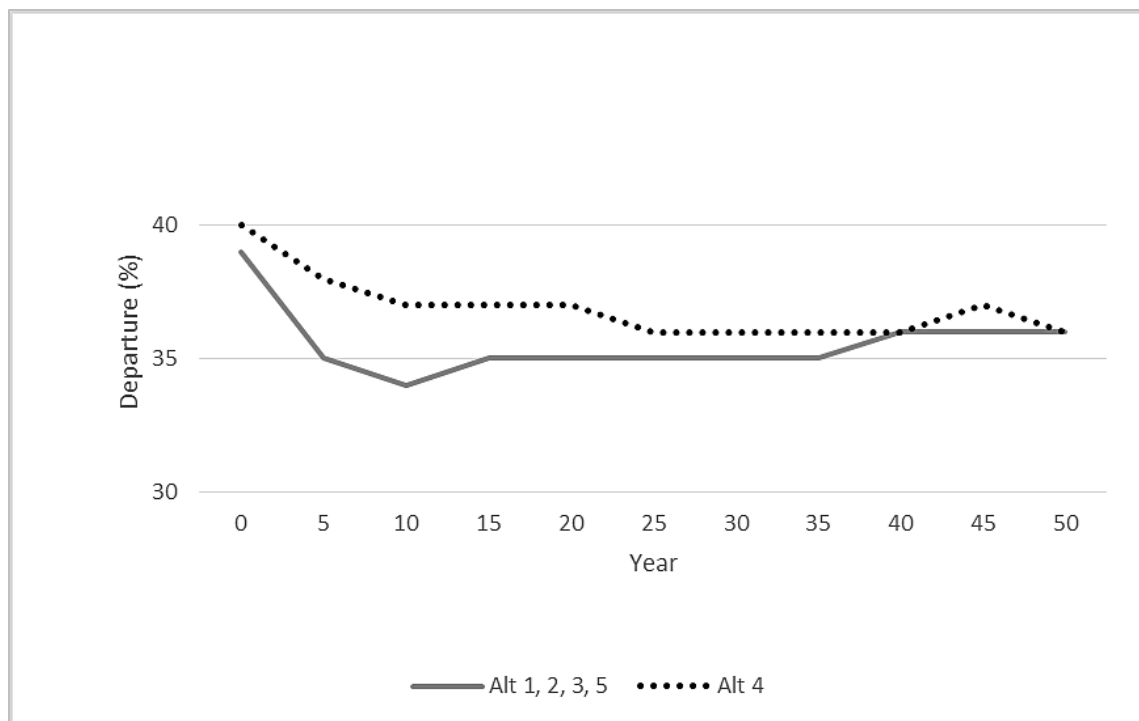


Figure 7. Piñon-juniper sagebrush seral state departure by alternative through year 50

Environmental Consequences for Woodlands - Alternative 4

All other action alternatives would include Grassland Maintenance Management Areas which preserve woodlands in a treeless state to promote forage production. Alternative 1 includes Management Area 11 – Revegetation Areas, which serve a similar purpose and are similar in their extent, though occur in slightly different locations. Under alternative 4, those areas would be managed using the same plan components as other piñon-juniper woodland and piñon-juniper sage vegetation communities. This would initially result in slightly higher seral state departure, because these cleared areas are included in the already overrepresented early seral grass states. Seral state departure lags behind that for other alternatives through year 50 as early seral states recover; however, woodland desired conditions would actually be applied to more total acres and ecological integrity of the vegetation community would be higher overall. There would be more acres managed toward desired habitat conditions for woodland-dependent species, but the habitat quality would be poorer on average compared to other action alternatives because the percentage of un-treed states would remain overrepresented.

Environmental Consequences for Woodlands - Alternative 5

Alternative 5 would recommend 10,663 acres of woodlands as wilderness. All but 60 of those acres would be in evaluated area W31d, which is unroaded (see appendix F), and mostly very steep and inaccessible. There would likely be little difference in the management or use of the area and, therefore, little difference in environmental effects compared to alternative 2.

Environmental Consequences for Sagebrush Shrublands

Discussion of modeling results and evaluation criteria

Modeled treatment levels in the sagebrush shrublands community do not differ among alternatives. Modeling for all alternatives predicts continued juniper encroachment and transition to an uncharacteristic treed state. As a result, seral state departure increases through year 50 (figure 8).

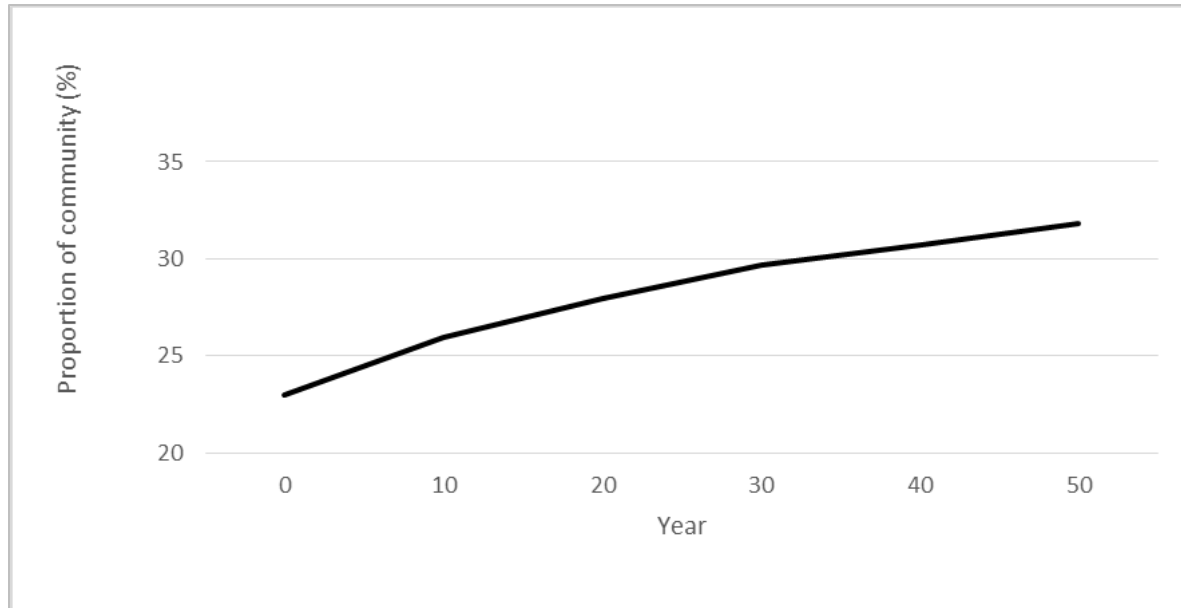


Figure 8. Proportion of the sagebrush shrubland vegetation community in an uncharacteristic treed state through year 50

Environmental Consequences for Sagebrush Shrublands Common to All Alternatives

Under all alternatives modeling predicts continued encroachment by juniper, leading to higher departure and lower ecological integrity. Patch size, already larger than desired, would continue to increase. This encroachment would likely be partially mitigated by un-modeled impacts such as drought, insect-induced mortality on marginal tree sites, and tree removal for fuelwood. Insect and disease dynamics are not expected to be significantly influenced by any alternative. Fire regime is not expected to be significantly influenced by any alternative. Tree encroachment will continue while fires may become slightly more common, and fire regime condition class is likely to remain mostly condition class II.

Environmental Consequences for Sagebrush Shrublands – Alternative 1

Gamma grass cover and overall vegetative groundcover would likely remain low, the result of degraded soils, probable drought, and continued grazing.

Environmental Consequences for Sagebrush Shrublands Common to Alternatives 2, 3, 4, and 5

Action alternatives provide more detailed descriptions of those conditions that would promote ecological integrity. Soil condition and understory herbaceous cover would be improved. There are plan components that direct management to maintain site-appropriate levels of understory vegetative cover, which would improve soil function, moisture retention, and nutrient cycling (FW-SAGE-DC-4, FW-SL-DC-1, -3, FW-WSW-DC-6, FW-GRZ-DC-5, FW-GRZ-S-1, FW-GRZ-G-1). The presence of biological soil crusts is desired to improve nutrient cycling and stabilize soils (FW-SAGE-DC-5, FW-SL-DC-4). Seral state distribution and tree density would be managed according to specifically defined desired conditions to improve overall ecological integrity.

Environmental Consequences for Grasslands

Discussion of modeling results and evaluation criteria

Modeled treatment levels in the montane-subalpine grassland ecological response unit do not differ among alternatives. Modeling for all alternatives predicts continued tree and shrub encroachment and a

transition to an uncharacteristic non-grass state. As a result, seral state departure increases through year 50.

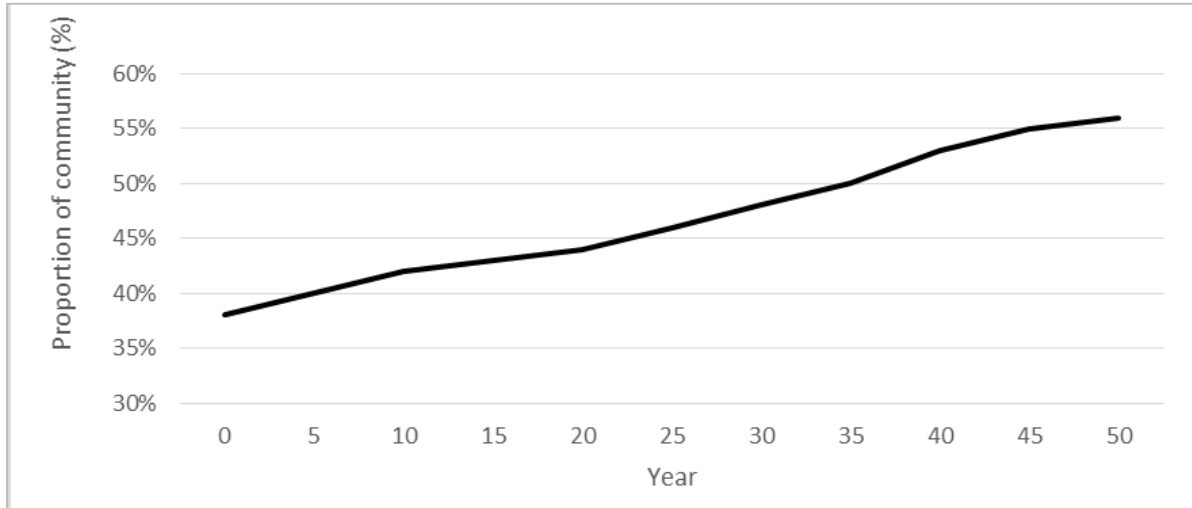


Figure 9. Proportion of the montane-subalpine grassland vegetation community in an uncharacteristic tree state through year 50

In other vegetation communities, early seral grass states would decline under all alternatives through the first 50 years. In spruce-fir forest, mixed conifer with frequent fire, and sagebrush shrubland this represents a transition away from desired conditions, while other communities would move toward desired conditions. Overall, alternatives 2, 3, and 5 would be close to desired conditions for total acres of grass states by year 50. The cumulative acres of open grass seral states based on desired conditions for each vegetation community is 217,634 acres.

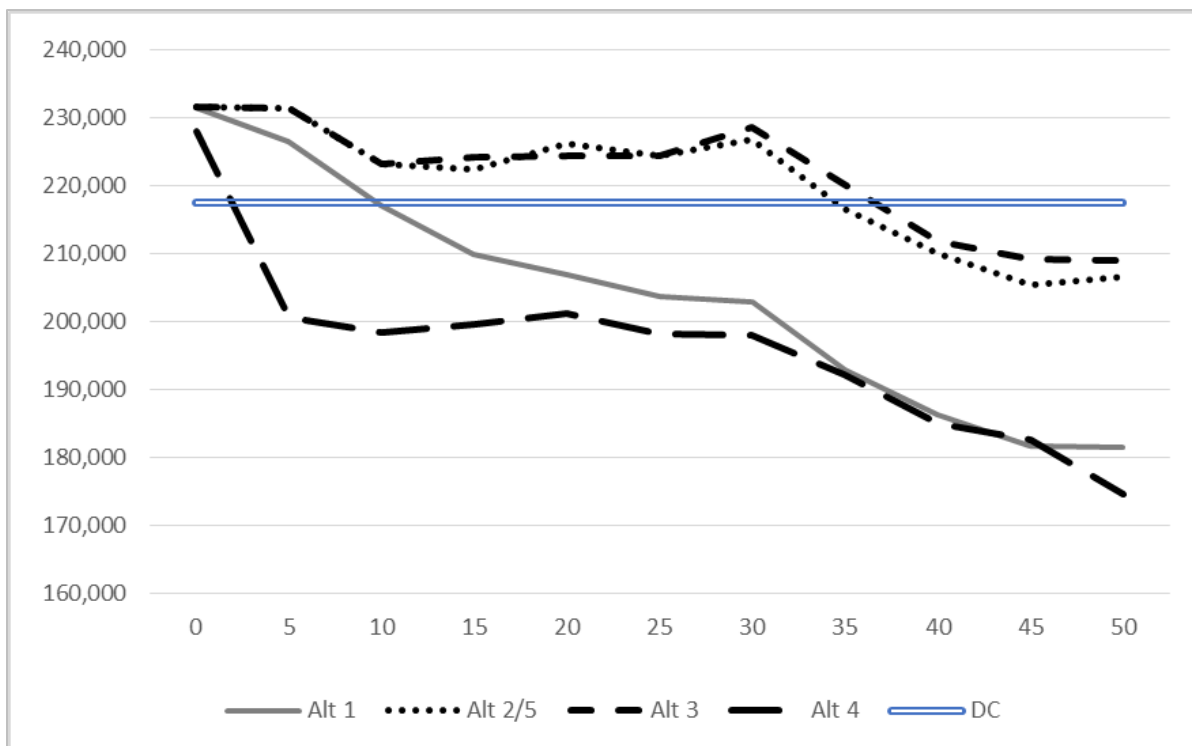


Figure 10. Acres of open grass seral states in all vegetation communities by alternative

Environmental Consequences for Grasslands Common to All Alternatives

Under all alternatives modeling predicts continued encroachment by woody species, leading to higher departure and lower ecological integrity. Likely this encroachment would be partially mitigated by unmodeled impacts such as drought and insect-induced mortality on marginal tree and shrub sites and tree removal for fuelwood. There would be a sudden drop in all alternatives by year 5 as meadows in spruce-fir forest infill with trees, which is not likely at the rate or to the degree modeled. The grassland maintenance management areas in ponderosa pine forest, piñon-juniper woodland and piñon-juniper sage in alternative 4 would quickly fill with trees, though probably not as quickly as modeled. After year 10, there would be a leveling off under all action alternatives and a continued steady decline under alternative 1.

Ruderal species (first to colonize disturbed sites) such as Kentucky bluegrass would continue to establish dominance by outcompeting and displacing native bunchgrasses, especially on sites where native vegetation has been reduced or removed. Drought probability and severity are likely to increase in the future (USDA FS 2010c), leading to reduced grassland productivity, lower overall groundcover, shifts in species composition, and soil instability. Stressed grasslands would be more susceptible to invasive species invasion. There is significant uncertainty regarding how these factors will interact to influence patch size under all alternatives. There may be more fire in grasslands under the action alternatives, but fire frequency is likely to remain below the desired frequency under all alternatives and fire regime condition class will remain mostly in condition classes II and III. Insects and diseases are not a significant characteristic of this system and are not expected to become one under any alternative.

Environmental Consequences for Grasslands – Alternative 1

Tree encroachment into grasslands would be greatest under alternative 1, resulting in reduced habitat, lower soil moisture, and increased soil erosion. At year 50, alternative 1 would have slightly less tree encroachment than alternative 4, because some areas would be managed to maintain grass cover (MA-11 Revegetation Areas). But the locations of grasslands would be less desirably distributed because they are defined by a static management area instead of as a shifting mosaic. Smaller meadows and grasslands in other management areas would be more likely to be lost to tree encroachment, resulting in less abundant and connected habitat.

Environmental Consequences for Grasslands Common to Alternatives 2, 3, 4, and 5

Woody species removal and grassland restoration in the montane-subalpine grassland vegetation community would likely be similar under all alternatives. All alternatives, including alternative 1, have direction to treat woody species encroachment in grassland types when it exceeds 10 percent. However, the treatment objectives in other vegetation communities under the action alternatives would improve the condition and abundance of seral grasslands in those communities compared to alternative 1. In addition, the increased levels of mechanical and fire treatment in action alternatives would likely have benefits in montane-subalpine grassland when mechanical treatment or prescribed fire include a portion of that vegetation community.

All action alternatives include plan direction regarding herbaceous vegetation diversity, amount, and structure (FW-VEG-DC-14). They have direction to manage toward site potential for understory vegetation (FW-VEG-DC-21). Importantly, each vegetation community contains direction to manage for grassy openings and interspaces appropriate to the community. Managing toward that desired overstory structure would contribute to more abundant herbaceous understories, and better habitat connectivity, nutrient cycling, soil protection, and soil function as a result.

Environmental Consequences for Riparian

Evaluation criteria that are measurable and vary by alternative differ for riparian vegetation compared to upland vegetation. The overarching basis for comparison remains ecological integrity, but the criteria includes vegetation structure and composition; upland condition and overall watershed function; fire effects, both direct effects to riparian areas and indirect effects from sedimentation and accelerated runoff; and hydrologic function, including channel shape, floodplain connectivity, and groundwater connection. These criteria are indicators of integrity, not an exhaustive list of all factors that may impact integrity or that may vary among alternatives. Other ecosystem characteristics such as flood regime, beaver activity, vegetative cover, coarse woody debris, and ecological status are not explicitly modeled or predicted based on the plan components described by the alternatives. In some cases, they may be inferred based on those criteria listed above. Where possible these other characteristics are discussed qualitatively.

Environmental Consequences for Riparian Common to All Alternatives

Some trends in riparian condition are clear based on water availability, water use, and upland watershed conditions. Current levels of human disturbance and the associated impacts are expected to continue. These include the combined impacts from roads, concentrated recreation, grazing, and other development that increase siltation and removal of vegetative cover and reduce infiltration, compared to historic levels. Introduced grass species, like Kentucky bluegrass, are expected to persist and expand. Beaver populations may continue to recover, but will be maintained below historic levels, due to competing demands, such as wildlife and livestock foraging, which limit woody species establishment, maintaining consistent stream flow for acequias and agriculture, and preventing flooding of infrastructure of fields used for agriculture or grazing.

Riparian systems will be influenced by trends in adjacent uplands. Lack of functional vegetative cover at lower elevations on the Carson will continue to alter runoff, such that headcutting and stream incision are likely. Increased biomass in frequent fire forests may reduce instream flows through increased evapotranspiration, but may also make organic matter more available, particularly as mortality increases. Increased risk of large, severe wildfire and insect and disease outbreaks may have direct impacts on riparian vegetation in the form of uncharacteristic mortality, and may also impact stream function through increased runoff and sediment loads originating from burned areas.

Projected future drought conditions will exacerbate water quality problems by concentrating pollutants. Projected lower flows will also reduce instream habitat, soil moisture, and groundwater levels, resulting in changes in species composition and productivity. Projected overall conditions will favor upland adapted species over existing riparian species (NM 2005b). Projected more-frequent, extreme flood events will degrade stream channel morphology and function. Bank erosion, sediment transport, runoff contamination, and scouring of debris from stream channels are all projected to intensify (Meyer et al. 1999). While mean runoff may decline, and peak timing may shift, riparian condition will be impacted most significantly by projected extremes of drought and flooding (Meyer et al. 1999). Cottonwood establishment, for example, is more dependent on timing of spring floods and inundations duration, than on total average streamflow (Auble et al. 1994; Poff et al. 2002). More variable flow will likely drive the need for more storage, particularly in combination with demand from a growing human population (NM 2005b). If the solution is to construct additional impoundments, habitat may be further fragmented (Meyer et al. 1999). Continued streamflow regulation will continue to impact riparian species composition by reducing regeneration by flood dependent species (e.g., Rio Grande and narrowleaf cottonwood).

Current Forest Service policy directs compliance with required Federal Clean Water Act permits and State regulations, and requires the use of best management practices to control nonpoint source pollution to meet applicable water quality standards and other Clean Water Act requirements. The Carson NF has a memorandum of understanding with the State of New Mexico that requires the forest to implement best

management practices. Best management practices are project design features that minimize impacts of management activities, protect watershed function, and maintain water quality (USDA FS 2012b). All action alternatives require that activities include best management practices that mitigate impacts to water quality, water quantity, and timing of flows, and prevent or reduce accelerated erosion (FW-WSW-G-1). Under all alternatives the incorporation of best management practices in project implementation would minimize impacts to riparian areas. Many practices for maintaining water quality involve protecting the structure and function of riparian areas. Implementation of best management practices would reduce soil erosion, compaction, displacement, and loss of structure, prevent overutilization of forage, prevent contaminant introduction, reduce bank instability, and preserve vegetation production. Best management practice resource categories with particular influence on riparian vegetation condition include wildland fire, rangeland, recreation, road, and mechanical vegetation management activities.

Prescribed fire, wildfire, and fire suppression would occur under all alternatives. Fire in the upland portions of a watershed may impact riparian areas through higher sediment input, stream channel damage from increased flooding intensity and frequency, and a general decrease in basin stability (Neary et al. 2005). The magnitude of fire effects in riparian areas is closely related to fire intensity. High-intensity fire can cause profound changes in plant cover and soil function, and can indirectly increase streamflow velocity, sedimentation rates, and water temperatures. Fire may also have beneficial effects in riparian areas such as removing light-competing, non-riparian vegetation, thereby allowing native riparian species to reestablish. An example of a best management practice for wildland fire is using ignition techniques, control methods, and access locations for ignition and control that minimize potential effects to soil, water quality, and riparian resources. For example, mid-slope ignition may be used to protect riparian areas, allowing a lower intensity fire to burn downslope toward riparian vegetation while achieving other, higher intensity objectives upslope.

Permitted livestock grazing would continue under all alternatives. Riparian areas have the capacity to produce forage in greater amounts and for longer periods than do the surrounding uplands due to more available moisture and deeper soils. They may therefore attract concentrations of herbivores which can in turn lead to detrimental overuse, degraded riparian function, and reduced long-term forage productivity. When upland forested canopies are maintained in more open condition, they produce more forage, which can help reduce grazing pressure on adjacent riparian areas. All range allotment management plans direct the use of best management practices and site-specific mitigation to reduce direct grazing effects to riparian function. Rangeland management best management practices include establishing annual endpoint indicators of use at levels suitable to maintain or achieve desired conditions for uplands, riparian areas, and aquatic ecosystems; establishing triggers for management actions, such as modifying intensity, frequency, duration, and timing or excluding livestock use; using suitable tools to alter livestock distribution; and identifying management strategies and riparian improvement needs to maintain or move toward achieving desired conditions.

Riparian areas often attract recreation activities such as motorized travel, camping, hiking, mountain biking, and horseback riding. If not properly managed, these activities have the potential to impact riparian areas by crushing, displacing, or physically removing vegetation, resulting in loss of canopy and ground cover. If activities occur when soils are saturated, severe rutting may occur, which can lead to erosion and loss of native riparian vegetation. Recreation activities have the potential to introduce and spread terrestrial and aquatic invasive species that compete with native plants for space, water, and nutrients. Recreation-related best management practices that effect riparian areas include, periodically evaluating the condition of soil, water quality, and riparian resources at and near developed sites to identify signs of insufficient ground cover, detrimental soil compaction, excessive runoff, sedimentation, or chemical or pollutant release by recreationists and managing use to avoid, minimize, or mitigate adverse effects to soil, water quality, and riparian resources by, for example, limiting group size and periods of use.

Roads that cross riparian areas have direct impacts through vegetation removal and water flow alteration. Roads outside of riparian areas may have indirect riparian effects including concentration of overland flow, increased sedimentation, and accelerated runoff with increased peak flows and related damage. An example of road best management practices is to not permit casting of road maintenance-generated debris into the Riparian Management Zone to avoid or minimize excavated materials entering waterbodies or riparian areas.

The potential for accelerated erosion, soil compaction, or other riparian impacts during or following mechanical treatment depends on climate, soil type, site conditions, equipment, and techniques utilized. Some best management practices to manage sedimentation include, re-establishing vegetation as quickly as possible and maintaining sufficient ground cover to minimize erosion and trap sediment. Examples of best management practices for mechanical treatment near riparian areas are, avoiding the introduction of excessive slash into riparian zones and waterbodies; retaining trees for canopy cover, shading, bank stabilization, and as a source of large woody debris; and avoiding felling trees into streams or waterbodies, except to create habitat features.

Best management practice prescriptions are translated into contract provisions, special use authorizations, project plan specifications, or other similar documents to ensure that the operator or responsible party is required to apply the best management practices. Monitoring of best management practice effectiveness informs and improves future management activities through adaptive management. Land management monitoring reports summarize best management practice monitoring results.

Environmental Consequences for Riparian – Alternative 1

Alternative 1 applies the same very specific desired future conditions to all riparian areas, including three or more age classes of woody plants and large diameter trees up to 240 years old. Those desired conditions are not applicable in some riparian types. For example, bogs and wet meadows are included in the list of types of riparian areas, but are places where woody plants or large trees may not be desirable. Therefore, for some herbaceous riparian types, plan direction does not address specific characteristics that would contribute to their ecological integrity. There are no specific objectives to treat riparian areas, though it is implicitly encouraged and would occur as opportunities arise.

Relatively low levels of upland restoration would continue to occur under alternative 1, with several indirect impacts on riparian vegetation. First, uncharacteristic fire in the surrounding watershed may result in higher sediment input, greater stream damage from increased peak flows, and a general decrease in basin stability. Higher intensity fires in adjacent forests may have more severe effects in riparian areas, removing riparian cover and streambank protection. Poor upland forage production may concentrate grazing and browsing pressure in productive riparian areas instead of distributing it throughout the watershed. Deficient coarse woody debris and poor soil conditions store less water in the uplands and may lead to accelerated runoff, increased erosion, and increased sedimentation.

Traditional road location, design, construction, and maintenance methods left a legacy of negative impacts on riparian areas across the forests. Under alternative 1, there are no objectives to decommission or naturalize unneeded roads, and to some degree these impacts would continue. Besides conversion of productive riparian land to roadbeds and ditches, other effects of legacy roads include (DeBano and Schmidt 1989):

- Dewatering due to lowered channel bed, nick points, and gully formation where roads cross rivers.
- Accelerated runoff, causing increased peak floods and related damage.
- Increased channel bed and bank erosion.
- Increased downstream sedimentation from eroding soil.

- Conversion from riparian to upland species that tolerate drier conditions.
- Reduced habitat for riparian dependent wildlife species.

Environmental Consequences for Riparian Common to Alternatives 2, 3, 4, and 5

Action alternatives 2, 3, 4, and 5 define riparian management zones (RMZs) and apply plan components to them that protect riparian functions. Compared to alternative 1, management activities, permitted uses, and structural developments within riparian management zones would move water, soil, and vegetation closer to desired conditions (FW-WSW-RMZ-G-2).

All action alternatives separate riparian vegetation into two broad groups based on their potential to support woody species. Wetland Riparian (WR) vegetation is treated separately from Forest and Shrub Riparian (FSR) vegetation and has its own plan components that would promote ecological integrity in that vegetation system. Seral state desired conditions are defined for Forest and Shrub Riparian types (FW-WSW-RMZ-FSR-DC-1, 2, 3). These more-targeted, though less prescriptive, plan components would better define desired structure, species composition, and function for the full range of riparian types on the Carson NF, directing management to better promote ecological integrity. Plan components (FW-WSW-RMZ-FSR-DC-5 and FW-WSW-RMZ-STM-DC-10) describe specific desired levels of coarse woody debris for specific riparian types that would improve aquatic habitat and stream function.

Environmental Consequences for Riparian - Alternative 2

Alternative 2 includes objectives to restore structure and function of at least 200 to 300 acres of riparian areas annually, and objectives to restore, enhance, or maintain streams and springs. Treatments may occur anywhere on the Carson NF, where they are determined to be appropriate. Riparian structure, composition, and function would be improved and maintained (more similar to desired conditions) in these areas. Elsewhere, riparian function would improve due to improved general condition of upland vegetation and watershed function. Terrestrial and aquatic habitat, surface flow timing and duration, sediment transport, floodplain connectivity, and surface-subsurface interactions would all be closer to desired conditions than under any other alternative.

Environmental Consequences for Riparian - Alternative 3

Alternative 3 includes the same objectives as alternative 2 for restoration of riparian areas, streams, and springs. Fewer components would require a reduction of road impacts, and mechanical treatments would at least double compared to alternative 2. Vegetation removal and crushing would occur in some localized areas. There would be greater potential for invasive species spread by motor vehicles. Fire would be less distributed across the landscape. Overall watershed conditions would be worse compared to alternative 2, with cascading impacts on riparian function. Surface flow timing and duration, sediment transport, floodplain connectivity, and surface-subsurface interactions would be negatively impacted.

Environmental Consequences for Riparian - Alternative 4

As in alternative 2, riparian structure, composition, and function would be improved and maintained (closer to desired conditions) in general across the forest. However, overall watershed conditions would be worse compared to alternative 2, with cascading impacts on riparian function. Alternative 4 limits motorized access through several means, including stricter guidance regarding the creation of new permanent or temporary roads (FW-TFA-S-3, -4), obliterating or naturalizing double the number of miles of non-system roads (FW-TFA-O-1), expanding the San Antonio Management Area and requiring seasonal closures (MA-SAMA-S-8, -9), and prohibiting new permanent roads or motorized trails in the Wetland Jewels Management Area (MA-WJMA-S-1). Direct riparian impacts such as sedimentation and vegetation removal would be slightly reduced overall. Invasive species spread would be slowed somewhat related to reduced access by motorized vectors, but treatment to restore riparian function may also be

made more difficult in some locations. The likelihood of uncharacteristically high-severity fire would be high, resulting in the potential for flooding and increased sedimentation that may remove or bury riparian vegetation and scour stream channels, with lasting impacts to hydrologic function.

Alternative 4 would include an additional 1,375 acres of riparian in recommended wilderness compared to alternative 2. This would remove any motorized or mechanized impacts to these riparian areas; however, these areas currently contain no open roads and motorized and mechanized uses with riparian impacts are currently rare for the most part. Several of these additional recommended wilderness management areas include frequent fire forests, which would not be treated, and high-severity fire with impacts to watershed and riparian function would be likely in these places.

The Wetland Jewels management area would focus road obliteration and riparian restoration work in these areas rather than in priority watersheds, which focus riparian restoration activities in all other action alternatives. However, the efficacy or feasibility of treating these areas is not clearly greater than they are for treating other locations on the forest. In fact, treatment return on investment is likely to be low, since 49 percent of the Wetland Jewels management area is in either designated wilderness, recommended wilderness, or inventoried roadless areas, each of which restricts management options compared to other forest areas. For example, earthwork or moving boulders by hand is more costly, time consuming, and labor intensive than doing the same work with machinery.

It is not clear that the condition of wetlands in the Wetland Jewels Management Area is different than that of other wetlands on the forest, nor is it clear therefore that focusing restoration work in these areas is an effective approach for meeting desired conditions. No systematic forestwide assessment of riparian or wetland condition has been conducted on the Carson. The 2012 Watershed Condition Assessment did include indicators for aquatic habitat and riparian/wetland vegetation that were rated at a watershed scale. That assessment was used to inform the identification of priority watersheds which guide restoration in alternatives 2, 3, and 5. Table 26 lists acres of high-rated wetlands by function on the Carson and acres and percentage of these wetlands within the Wetland Jewels Management Area.

Table 26. Acres of wetlands on the forest by function and acres and percent of wetlands that occur in the Wetland Jewels Management Area

High-Rated Wetlands by Function	All Wetlands acres	Wetlands Jewels Management Area acres (percentage of wetlands)
All wetlands total acres	19,824	3,882 (19.6)
Aquatic invertebrate habitat	1,285	95 (7.4)
Carbon sequestration	16,864	3,268 (19.4)
Coldwater species	8,644	2,029 (23.5)
Discharge flow	12,574	3,188 (25.4)
Fish habitat	1,317	95 (7.2)
Fish shading	1,613	51 (3.2)
Headwater	11,709	3,650 (31.2)
Associated with impaired stream	5,010	1,039 (20.7)
Streamflow maintenance	1,043	464 (44.5)
Sediment retention	14,222	3,143 (22.1)
Surface water detention	2,705	218 (8.1)

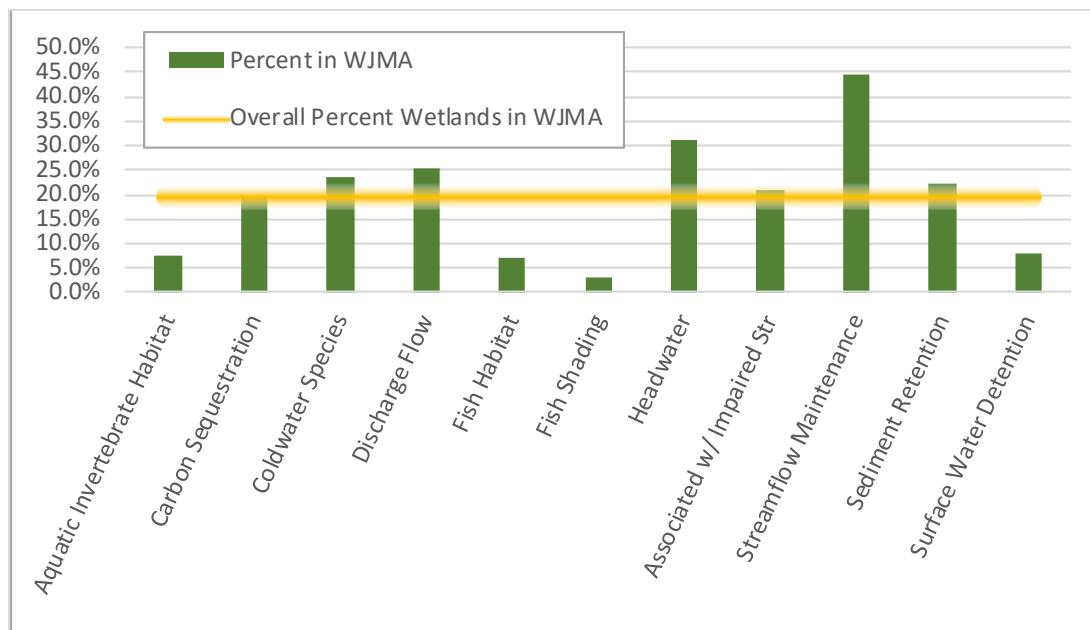


Figure 11. Percentage of wetlands with a high rating for each wetland function that fall in the Wetland Jewels Management Area (WJMA)

In addition to focusing restoration treatments, the Wetland Jewels Management Area also identifies a set of priority wetland functions (MA-WJMA-DC-1). Those functions align with mapped wetland characteristics. In 2015, GeoSpatial Services, in coordination with the New Mexico Environment Department, delineated and classified wetlands and riparian areas based on multiple characteristics related to type, and their association with stream impairments.² Wetlands are rated as moderate or high, depending on how well they perform a particular function. This classification is based on wetland type, not condition.

In figure 11, 19.6 percent of all wetlands across the forest are in the Wetland Jewels Management Area, represented by the horizontal yellow line. Wetland functions that are less likely to be rated high among wetlands in the Wetland Jewels Management Area fall below the yellow line (wetlands in the Wetland Jewels Management Area are less likely to have a high rating for that function than would be predicted by distribution alone). Wetland functions that are more likely to have a high rating when the wetland is in the Wetland Jewels Management Area extend above the yellow line. When the percentage of wetlands in the Wetland Jewels Management Area with a high rating for a function is close to 19.6 percent, it implies that the function is no more likely to be found in the Wetland Jewels Management Area than in other parts of the forest.

Based on these ratings, it is not clear that the Wetland Jewels Management Area includes the most appropriate locations to maintain or improve priority wetland functions, as required by MA-WJMA-DC-1. In fact, of the 11 wetland functions, wetlands in the Wetland Jewels Management Area are more likely to be highly rated for just six functions: coldwater species, discharge flow, headwater, associated with an impaired stream, streamflow maintenance, and sediment retention. This means that for the other five functions, wetlands in the Wetland Jewels Management Area are less likely to perform a particular function well, compared to other wetlands on the forest. For example, surface water detention is one of the functions that must be maintained or improved in the Wetland Jewels Management Area (MA-WJMA-DC-1); however, wetlands in the Wetland Jewels Management Area are less likely than other wetlands to perform that function at a high level. Therefore, surface water detention by wetlands across

² Available here: <http://www.geospatialservices.org/nwi-projects>.

the forest would be degraded by focusing on that function only in the Wetland Jewels Management Area. The same is true for aquatic invertebrate habitat, carbon sequestration, fish habitat, and fish shading.

Wetlands that are associated with known impaired streams were identified by intersecting wetland boundaries and impaired streams data.³ Of these impaired-stream-associated wetlands only 21 percent are within the Wetland Jewels management area. That is, impaired-stream-associated wetlands are not more likely to occur in the Wetland Jewels Management Area than they are anywhere else on the forest (table 26 and figure 11). Therefore, treating degraded wetlands in the Wetland Jewels Management Area is not more likely to improve forestwide impaired streams than treating degraded wetlands anywhere else on the forest, especially since stream impairments may result from a number of factors that are unrelated to headwater wetland condition.

Forestwide, maintenance of the priority wetland functions would be weighted toward those functions that are more common in the Wetland Jewels Management Area, while other priority wetland functions would be less well-maintained under alternative 4 compared to other action alternatives, where wetland restoration and management is guided by forestwide plan components. By area, most Wetland Jewels Management Areas contain just a small percentage of wetlands (mostly well below 10 percent, Bobcat Pass at 19 percent is an exception, see table 27). Except for the La Jara Canyon and McCrystal Creek Wetland Jewels Management Areas, the non-wetland areas in every Wetland Jewels Management Area are commonly in the Spruce-Fir Forest vegetation community, with some areas (Midnight Meadows, Serpent Lake) covered by as much as 85 percent Spruce-Fir Forest. In this vegetation community FW-VEG-SFF-G-1 limits soil and vegetation disturbance to “confined and localized areas” with no long-term impacts. The forestwide plan components for watershed, riparian management zones, wetland riparian, and spruce-fir forest would be more effective at and focused on maintaining wetland function than the Wetland Jewels Management Area plan components. For example, MA-WJMA-S-2 prevents the construction of new powerline or fiber optic line infrastructure anywhere in the Wetland Jewels Management Area, even if that infrastructure might be built in an existing easement or on an upland site without impact to wetlands. The Bobcat Pass and La Jara Wetland Jewels Management Areas both include existing power lines and instead of co-locating new infrastructure or replacing infrastructure in the same location, it would have to be located outside of the Wetland Jewels Management Area, requiring additional resource disturbance.

Table 27. Total acres of wetlands and spruce-fir forest vegetation community in the Wetland Jewels Management Area

Wetland Jewels Management Areas	Total Acres	Wetland (acres)	Spruce-fir forest (acres)	Wetlands (percent)	Spruce-fir forest (percent)
Bobcat Pass	3,029	577	1,738	19.0%	70.9%
Brazos	3,378	295	1,386	8.7%	45.0%
Canjilon Lakes	3,650	207	1,800	5.7%	52.3%
Cruces Basin	16,531	373	12,610	2.3%	78.0%
La Jara Canyon	2,638	181	19	6.9%	0.8%
McCrystal Creek	17,107	653	540	3.8%	3.3%
Midnight Meadows	4,445	313	3,705	7.0%	89.7%
Rio Santa Barbara	7,416	187	5,116	2.5%	70.8%
Serpent Lake	11,708	256	9,769	2.2%	85.3%
Valle Vidal	9,794	753	4,443	7.7%	49.1%

³ Available at: <http://smumn.maps.arcgis.com/apps/MapSeries/index.html?appid=c26c3b06242e4e3bac4e4c04f3839b27>

Forestwide wetland conditions would be slightly worse under alternative 4 because restoration overall would be slightly less effective. Some wetland improvement may occur in the La Jara Wetland Jewels Management Area because there would be less opportunity for road, trail, and infrastructure development there. But in La Jara, as in all other Wetland Jewels management areas, any of that type of development under alternative 2 would be constrained by watershed, wetland riparian, and riparian management zone plan components and any additional wetland impact would be minimal. All other Wetland Jewels management areas would be subject to additional constraints under alternative 2 from either the spruce-fir forest vegetation community plan components, the Valle Vidal Management Area, the San Antonio Management Area, or a combination, and there would be essentially no difference in wetland conditions in these areas.

Cumulative Environmental Consequences for Vegetation Communities and Fuels

The Carson is inherently connected to its surrounding landscape, despite administrative boundaries. The cumulative effects that past activities have had on vegetation and fuels have been discussed in detail as part of the affected environment for vegetation and fuels generally and by vegetation community. Throughout the broader landscape, past management practices have resulted in forest conditions that are departed, creating a risk of not achieving desired conditions in the future. Trees are smaller and younger overall than they would have been historically, and fuels are built up and more continuous. Grasslands are encroached on by woody species and current herbaceous understory cover is lower than the potential.

Broad regional stressors that may intensify in the future include rising population levels and participation in outdoor recreation, both locally and nationally, with resulting increased demand for and pressures on public lands. Higher temperatures and more frequent drought will likely lead to increased fire frequency and severity, and increased demand for high-elevation recreation opportunities. Related to vegetation conditions, these changes may lead to increased demand for commercial and noncommercial forest products, elevated importance of public lands in providing for the habitat needs of displaced wildlife species, and changing societal desires related to the mix of uses that public lands should provide. Growing recreation use over the planning period due to increasing population levels and demand in the surrounding area could affect ecosystem integrity. However, the sustainable recreation plan direction included in all action alternatives provides measures to mitigate such impacts from recreation activities.

Riparian areas are particularly susceptible to effects from outside the Carson's boundaries. One-third of all riparian vegetation on the Carson is contained within private inholdings, where the forest does not influence management. The impacts to riparian systems in these areas are expected to continue or intensify. These include impacts from water extraction and impoundment for agriculture and other uses; impacts (runoff and sedimentation) from agriculture; grazing; or other private land development; impacts (reduction of groundcover and bank destabilization) from livestock grazing; and impacts from the conversion of wetlands to other uses (loss of habitat, reduced water retention and storage).

Cumulative effects to vegetation are examined within a larger-than-Carson-NF, broad, spatial context for analyzing the combined contribution of forestwide management and management of adjacent lands to environmental impacts on the landscape (table 28). The effects of proposed management are evaluated in the context of management actions of other entities occurring within the boundaries of the context landscape (USDA FS Carson NF 2015a). That landscape includes portions of four eco-regional sections with distinct land ownership, use, and management (table 29 and figure 12).

Overall, cumulative environmental effects of proposed management under all alternatives, in the context of the larger landscape, would contribute to the movement of vegetation toward desired conditions. Proposed management would contribute to landscape restoration, control of invasive species, reduction in uncharacteristic wildfire across the broader landscape, and the resiliency and adaptability of vegetation communities to climate change.

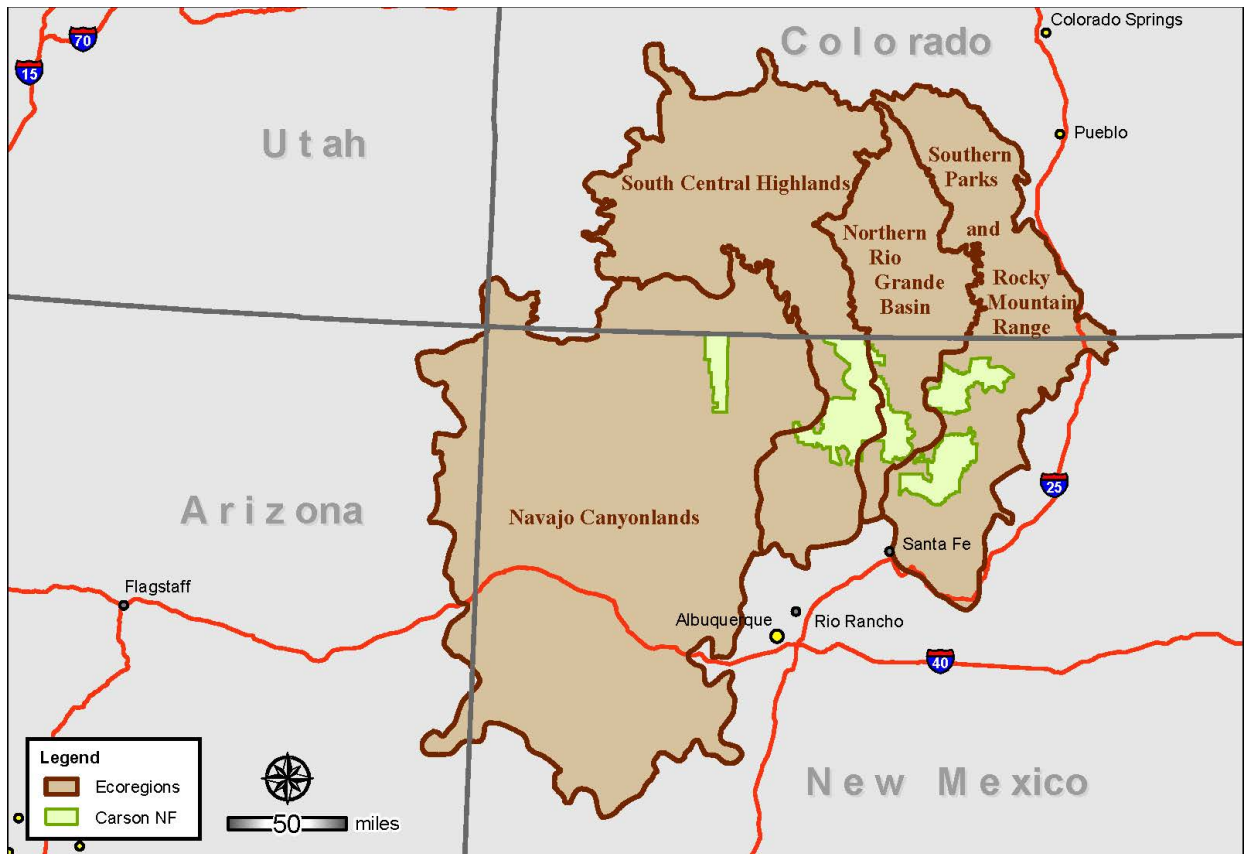


Figure 12. Ecoregions that intersect the Carson National Forest

Table 28. Management plan summaries for other lands in the cumulative effects landscape

Agency	Management Plan Description and Relevant Effects	Timeframe
BLM-Taos Field Office	<p>The Taos Field Office would continue to support the Restore New Mexico Partnership, a partnership of government agencies, ranchers, industry, non-profit organizations, and others to restore New Mexico's grasslands, woodlands, and riparian areas to a healthy and productive condition. Under this partnership, all BLM field offices in New Mexico work to treat lands, regardless of ownership, across a landscape or watershed to defragment and improve the ecological health and habitat. The goal is to restore desert grasslands and woodlands to their natural states, where possible. This would be accomplished by treating those areas where encroachment by invasive shrubs has occurred and reclaiming disturbances from past permitted actions that have fragmented the habitat.</p> <p>Restore fire frequency and intensity regimes to pre-European settlement levels by reducing fuel loads.</p> <p>Reestablish appropriate vegetation communities to maintain natural fire regimes.</p>	Current
BLM-Farmington Field Office	<p>The objective of the FFO fire program is to manage and use fire consistent with its natural role in the functioning ecosystem, and the protection of life and property.</p> <p>The objective of the rangeland program is to promote healthy sustainable rangeland ecosystems; to accelerate restoration and improvement of public rangeland to properly functioning condition; to promote the orderly use, improvement, and development of the public lands; to efficiently and effectively administer domestic livestock grazing; and to provide for the sustainability of the western livestock industry and communities that are dependent upon productive, healthy public rangelands.</p>	Current and under revision
BLM-San Luis Field Office Resource Management Plan (1991)	<p>Maintain present good to excellent condition range; move toward good condition (late seral stage) on fair to poor condition range based on site potential.</p> <p>Harvest 185 mbf (5,769 acres of operable commercial forest lands) annually during the life of the plan. Thirty-four acres of commercial forest land would be replaced annually through regeneration harvest. Harvest 477 cords of fuelwood (11,992 acres of productive operable woodlands) during the life of the plan or 53 acres annually.</p> <p>Any fire, including wildfires, occurring in the resource area would be suppressed.</p>	Current
NMED – Forest and Watershed Health Plan	<p>Ecological: Promoting ecological integrity, natural processes, and long-term resiliency is the primary goal of the New Mexico Forest and Watershed Health Plan.</p>	2004
NMED – New Mexico Forest Action Plan	<p>Over the next five years (2016-2020), New Mexico State Forestry Division will focus on maintaining and increasing the momentum gained recently through development of the state's Watershed Restoration Initiative. Working with our private and public land management partners, we will improve the health of priority landscapes and restore New Mexico's forests to a more resilient condition.</p> <p>Theme 1: Conserve and Manage Working Landscapes for Multiple Values and Uses</p> <p>Theme 2: Protect Watersheds from Harm</p> <p>Theme 3: Enhance Public Benefits from Natural Resources</p>	Current

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Agency	Management Plan Description and Relevant Effects	Timeframe
San Isabel National Forest Land and Resource Management Plan (1984, revised 2008)	<p>Maximize present net value while emphasizing opportunities to improve water, fish and wildlife, outdoor recreation, and other amenity values.</p> <p>Manage resources at economically and environmentally feasible levels, consistent with emphasis on amenity values.</p> <p>Reintroduce, where desirable and feasible, the natural role of fire in maintaining the proper functioning and health of natural communities, and to reduce the long-term threat of catastrophic wildfires</p>	Current
San Juan National Forest Land and Resource Management Plan (2013).	<p>The composition, structure, and function of terrestrial ecosystems are influenced by natural ecological processes, including disturbance events such as fire, infestations by insects or disease, winds, and flooding. Key ecosystems that are not functioning properly are realigned/restored/renovated to survive the near-future dynamics of changing climate.</p> <p>Major vegetation types reflect little or no departure from historic range of variation of fire frequency and intensity (e.g., reflect Fire Regime Condition Class 1).</p>	Current
Rio Grande National Forest Land Management Plan	<p>Provides quantitative desired conditions of development and structural stages for forested terrestrial ecosystems</p> <p>Vegetation management strategies are consistent with historical succession and disturbance regimes where possible.</p> <p>Major vegetation types reflect little or no departure from historic natural range of variation of fire frequency and intensity.</p>	Under revision
Santa Fe National Forest Land and Resource Management Plan	<p>Guidance documents have been developed by the Southwestern Regional Office (R3) revision team to provide regional consistency for plan revision under the 2012 Planning Rule. Vegetation desired conditions are very similar, based on regionally consistent guidance.</p>	Under revision
Native American Tribes –Integrated Resource Management Plans (various)	<p>“Plans vary widely in terms of approach, depth, content, and rigor; most plans are still primarily timber management plans, with some standards, guidelines or limitations imposed by other resources.”</p> <p>“On the whole, the health and productivity of Indian forests are being maintained, but forest density-related threats from fire, insects, disease, and climate change have and increasingly will compromise the long-term sustainability of Indian forests unless treatment measures are accelerated, and appropriate annual harvest targets can be met.”</p> <p>“Indian forestry operations are understaffed compared to other public and private forest management organizations.” *</p>	On-going; varies

*Assessment of Indian Forests and Forest Management in the United States. 2013. Indian Forest Management Assessment Team for the Intertribal Timber Council. http://www.itcnet.org/issues_projects/issues_2/forest_management/assessment.html

Table 29. Ownership by ecoregions in the context landscape

Ownership	Navajo Canyonlands (acres)	%	South Central Highlands (acres)	%	Northern Rio Grande Basin (acres)	%	Southern Parks and Rocky Mountain Range (acres)	%
Total	6,200,180	100	3,171,044	100	1,806,732	100	4,265,044	100
Carson	165,790	2.7	590,845	18.6	221,743	12.3	613,843	14.4
All Forest Service	535,599	8.6	2,319,195	73.1	225,353	12.5	1,417,764	33.2
Bureau of Land Management	1,320,837	21.3	38,404	1.2	532,756	29.5	147,554	3.5
Bureau of Indian Affairs	2,688,059	43.4	118,541	3.7	86,726	4.8	99,762	2.3
National Park Service	7,705	0.1	116,291	3.7	NA	0.0	45,854	1.1
Private	1,303,436	21.0	488,880	15.4	861,635	47.7	2,412,590	56.6
State Game and Fish	45,990	0.7	3,070	0.1	5,085	0.3	54,613	1.3
State Parks	15,176	0.2	268	0.0	NA	0.0	939	0.0
Other State	238,833	3.9	54,796	1.7	90,869	5.0	84,638	2.0
Bureau of Reclamation	26,509	0.4	NA	0.0	NA	0.0	NA	0.0
Department of Defense	NA	0.0	2,924	0.1	NA	0.0	801	0.0
Department of Energy	NA	0.0	26,244	0.8	NA	0.0	NA	0.0
Local	18,036	0.3	2,431	0.1	4,308	0.2	529	0.0

NA is not applicable.

Cumulative Environmental Consequences for Vegetation Communities and Fuels in the Navajo Canyonlands Ecoregion

The Carson NF is only 2.7 percent of the landscape in the Navajo Canyonlands ecoregion. The Jicarilla Ranger District is wholly contained by this ecoregion. The Jicarilla-Apache, Navajo Nation, and Southern Ute are the largest landowners, followed by BLM and private lands. The San Juan NF and Santa Fe NF also have land in the ecoregion.

Much of this landscape is leased for natural gas development. Localized vegetation disturbance from well pads, pipelines, and access roads is common. Reclamation reseeding includes nonnatives but contributes significantly to grassland habitat. The area provides important winter range for deer and elk, and a management focus is range improvement through grassland restoration. There are wild and feral horse herds on the Carson, Jicarilla-Apache lands, Southern Ute lands, Navajo lands, and BLM lands that are significantly overpopulated and have a negative impact on range condition by changing species composition and increasing erosion and soil loss.

Cumulative Environmental Consequences for Vegetation Communities and Fuels in the South Central Highlands Ecoregion

The Carson makes up 18.6 percent of the landscape in the South Central Highlands ecoregion. The ecoregion contains most of the Canjilon and El Rito Ranger Districts and the northwest portion of the Tres Piedras Ranger District. It also includes portions of the Santa Fe NF, the Rio Grande NF, and the San Juan NF, and nearly 75 percent of the landscape is managed by the Forest Service. Most of the rest is privately owned land in the Chama area.

The landscape has been recently impacted by large fires and beetle-induced mortality. A large portion of the piñon trees in the Chama River area were killed by the insects in the early 2000s. More recently, beetles have caused severe spruce mortality in Colorado. Large, stand-replacing fires have been common in the Jemez Mountains over the last two decades, including Cerro Grande, Thomson Ridge, and Las Conchas Fires. In Colorado, the Missionary Ridge, Little Sand, and West Fork Fires are all recent incidents, each larger than

24,000 acres. The combination of insect, disease, and stand-replacing fires has removed tree canopy cover over large areas of the landscape and converted some forested areas to grass or shrub cover for many decades into the future.

Cumulative Environmental Consequences for Vegetation Communities and Fuels in the Northern Rio Grande Basin Ecoregion

Carson makes up 12.3 percent of the landscape in the Northern Rio Grande Basin ecoregion. The ecoregion contains the southern and eastern portions of the Tres Piedras Ranger District. It contains large amounts of BLM land in New Mexico and Colorado, including the Rio Grande del Norte National Monument, but the largest ownership is by small private landowners in the plains around San Acacio, Colorado.

The majority of the vegetation communities in the landscape are Great Basin/semi-desert grasslands and shortgrass prairie, of which there are only a few acres on the Carson. Vegetation communities on the Carson are mostly montane-subalpine grasslands, ponderosa pine forest, and piñon-juniper/sage. Sagebrush shrublands are generally common on national forest and BLM lands. Encroachment into grasslands by woody sagebrush and piñon-juniper is a common issue, which reduces the productivity of grasslands and destabilizes soils throughout this landscape. Sagebrush condition is better on the Carson than off, and even though there are not many acres (fewer than 40,000) on the Carson in this area, they may serve as a refuge for species that rely on sagebrush shrubland habitat.

Cumulative Environmental Consequences for Vegetation Communities and Fuels in the Southern Parks and Rocky Mountain Range Ecoregion

The Carson makes up 14.4 percent of the landscape in the Southern Parks and Rocky Mountain Range ecoregion. The Questa and Camino Real Ranger Districts are wholly contained by this ecoregion. Other lands include Santa Fe National Forest, San Isabel National Forest, Rio Grande National Forest, Great Sand Dunes National Park, New Mexico State lands, and Taos Pueblo. Over half the landscape is privately owned, with large landowners including Philmont Boy Scout Ranch, Trinchera Ranch, Vermejo Ranch, Sandia Pueblo private lands, and Rio Costilla Cooperative Livestock Association.

There are over 500,000 acres of designated wilderness in this ecoregion, not including the over 50,000 acres of Blue Lake Wilderness on Taos Pueblo land. Altogether, this represents over 32 percent of all Federal/Tribal land management in the landscape. An additional 281,316 acres (16 percent) of Federal lands are inventoried roadless areas and the approximately 100,000-acre Valle Vidal unit (6 percent) is mostly managed for non-motorized recreation. Thus, over half of the Federal/Tribal lands are managed to restrict motorized uses and timber harvest. This has benefits to vegetation by limiting watershed-related road impacts, and may reduce the incidence of human-caused wildfire. However, it limits the type and amount of restoration and prescribed fire that are possible in this landscape. Tree densities are likely to remain high in some areas, with correspondingly high risk for uncharacteristic wildfire. Forest management in response to insect and disease outbreaks would be limited and the risk of future tree basal area loss is high (USDA FS 2014c).

Soil Resources

This section analyzes the soil resource by describing the current soil condition and projected trends in soil condition by alternative. It also describes the potential effects to soil conditions associated with management activities.

The Carson uses soil condition as a descriptive indicator of general soil health. Soil condition is based on the primary soil functions of soil hydrology, soil stability, and nutrient cycling. The current soil condition rating is based on how departed soils are from the reference condition. The projected trends in soil condition are based on estimates of vegetative ground cover, soil productivity, and organic matter.

Description of Affected Environment

Soil provides a foundational basis on which other organisms (including humans) depend. Soil provides numerous benefits to the ecosystem: (1) soil provides a substrate, nutrient source, and water source for plant growth, (2) soil provides a regulating environment for water—it controls where water goes, how quickly it runs off, and how much is infiltrated and stored, (3) soil provides a purification system for water, both surface flows and groundwater, (4) soil provides for climate thermoregulation (e.g., daytime heat absorption, nighttime heat release), and (5) soil provides a source of nutrients and nutrient cycling for its own maintenance of fertility. Soil also provides other benefits, such as wildlife habitat, sources for construction sites and materials, as well as a source of various traditional and contemporary cultural materials (clay, etc.) on which humans depend. Soils are a complex and dynamic system resulting from interactions between parent material, climate, topography, and organisms throughout time and space that consists of a mineral component, organic matter, air, water, and various soil organisms. Soils store water, supply nutrients for plants, and provide a medium for plant growth. Soils also provide habitat for a diverse number of belowground organisms. Due to their slow rate of formation, soils are essentially a non-renewable resource.

Soils are described, characterized, and classified in Terrestrial Ecosystem Survey of the Carson National Forest (USDA FS Carson NF 1987). Ecological map units are created for soils based on the climate, vegetation, geology, and landforms of the forest. The Carson uses ground cover and vegetation canopy cover for each mapping unit to establish a resource value rating for soil and plant health for many management activities (e.g., analysis and monitoring of restoration treatments and grazing allotment management).

Soils of the Carson are highly variable ranging from shallow to deep, fine to loamy, and skeletal (rock fragments over 35 percent of the whole soil) to non-skeletal. They occur on all slopes ranging from nearly level (less than 15 percent slope) to very steep (slopes greater than 80 percent). The parent material types include igneous (e.g., granite, basalt, andesite), metamorphic (e.g., gneiss) and sedimentary (e.g., sandstone, limestone, shale). Soils developed in parent material such as andesite and basalt tend to have more clay content because these parent materials are high in clay forming minerals. Conversely, soils formed from granite or rhyolite parent materials are lower in clay content because these parent materials have a lower percentage of clay-forming minerals. Sedimentary parent materials such as limestone result in the presence of calcareous soils.

Human and ecological systems rely on soil for water and nutrients essential for plant growth, the regulation of the water cycle, and the storage of carbon. The physical structure of soils, including organic material content, is critical to their nutrient balance, stability, water retention capability, and the diversity and abundance of soil organisms they contain. These factors, in turn, are important to the health of vegetation and watersheds, and the quality of habitat for wildlife.

Soil Condition

Soil condition is an evaluation of soil quality based on an interpretation of factors that affect vital soil functions. Soil quality is the capacity of the soil to function within ecosystem boundaries to sustain biological productivity, maintain environmental quality, and promote plant and animal health (Doran and Parkin 1994; USDA FS 2013c).

Soil condition is based on three soil functions: (1) the ability of the soil to resist erosion, (2) the ability of the soil to infiltrate water, and (3) the ability of the soil to recycle nutrients. Soil condition provides an overall picture of soil health vital in sustaining ecosystems. Soil condition rates soils as they currently exist and reflects the effects of management and disturbance history—soils were generally assumed to be in satisfactory soil condition under reference conditions.

The Terrestrial Ecosystem Survey identifies soil condition by ecological map unit and predicted soil loss. Current soil condition in this assessment reflects conditions from 1987, when the Terrestrial Ecosystem Survey was published. Since then, changes have occurred across the landscape as a result of natural disturbances (e.g., fire and drought), management (e.g., timber harvest), and human caused disturbance (e.g.,

roads, user-created trails). Satisfactory soil conditions have likely decreased, and unsatisfactory conditions have likely increased, in areas where disturbances have occurred.

Satisfactory soil condition (soil quality) is important in maintaining long-term soil productivity—key to sustaining ecological diversity. Unsatisfactory and unsuited (inherently unstable) soil conditions result in reduced ability of the soil to grow plants and sustain productive, diverse vegetation. Very little quantitative data exist to measure historical soil condition. However, some qualitative and quantitative inferences can be made, providing insight into historical soil condition by using knowledge about present disturbances and their effect on soil hydrology, soil stability, and nutrient cycling. Reference conditions generally estimate pre-European settlement conditions.

Soil Condition Categories

The Carson encompasses a broad range of ecosystems. These ecosystem types are mapped using the ecological response unit framework (Wahlberg et al. 2014). Ecological response units are mapped ecosystem types that are based on biophysical themes that represent the range of conditions that exist under natural disturbance regimes. Each ecological response unit is assigned a soil condition category which is an indication of the status of soil functions for that area. Soil condition categories reflect soil disturbances resulting from management or natural and human caused disturbances. Current management activities provide opportunities to maintain or improve soil functions that are critical in sustaining soil productivity. The following is a brief description of each soil condition category:

- **Satisfactory:** Indicators signify that soil function is being sustained and soil is functioning properly and normally. The ability of soil to maintain resource values and sustain outputs is high.
- **Impaired:** Indicators signify a reduction of soil function. The ability of soil to function properly has been reduced or there exists an increased vulnerability to degradation. An impaired rating should signal to land managers a need to further investigate the ecosystem to determine causes and degrees of decline in soil functions. Changes in management practices or other preventative actions may be appropriate.
- **Unsatisfactory:** Indicators signify that loss of soil function has occurred. Degradation of vital soil functions results in the inability of soil to maintain resource values, sustain outputs, and recover from impacts. Soils with an “unsatisfactory” rating are candidates for improved management practices or restoration designed to recover soil functions.
- **Unsuited:** Areas rated unsuited are those where geologic erosion rates are greater than soil formation rates (naturally erodible). Soils that do form are inherently unstable and may occur on steep slopes. These soils are generally associated with badlands and other miscellaneous areas.

Currently, approximately 50 percent of the Carson is rated in satisfactory soil condition, 44 percent unsatisfactory and 6 percent unsuited (table 30). Most areas that currently have an unsatisfactory soil condition would most likely have historically been in a satisfactory soil condition.

Five of the 10 upland ecological response units have a majority of satisfactory soil conditions. These ecological response units are spruce-fir forest, ponderosa pine forest, piñon-juniper woodland, mixed conifer w/aspens, and mixed conifer – frequent fire. The most productive soils (satisfactory soil condition) are within ecological response units that produce high amounts of organic matter to ensure stability of the soil and support nutrient cycling. Soil organic matter generates numerous benefits for the soil resource including improving water infiltration, soil aeration, and water holding capacity. Organic matter is an energy source for microorganisms and supplies nutrients for plant growth (Magdoff 2004). These benefits can provide maintenance of ecosystem productivity and site diversity.

Table 30. Soil condition class percentages for upland ecological response unit on the Carson NF

Ecological Response Unit	Satisfactory	Impaired	Unsatisfactory	Unsuited
Alpine and Tundra	0%	0%	36%	64%

Ecological Response Unit	Satisfactory	Impaired	Unsatisfactory	Unsuited
Montane and Subalpine Grassland	27%	0%	73%	0%
Bristlecone Pine	42%	0%	58%	0%
Spruce-Fir Forest	88%	0%	12%	0%
Mixed Conifer w/Aspen	76%	0%	24%	0%
Mixed Conifer Frequent Fire	100%	0%	0%	0%
Ponderosa Pine Forest	54%	0%	46%	0%
Piñon Juniper Woodland	51%	0%	49%	0%
Piñon Juniper Sagebrush	22%	0%	78%	0%
Sagebrush	40%	0%	60%	0%

The greatest areas of unsatisfactory soil condition are found in montane-subalpine grassland, bristlecone pine, ponderosa pine forest, piñon-juniper woodland, piñon-juniper sagebrush, alpine and tundra, and sagebrush shrubland ecological response units. The loss of soil productivity through a reduction in soil function is due to a lack of adequate vegetative ground cover and organic matter. Reduced vegetative cover in the alpine and tundra ecological response unit has resulted in unstable soils with reduced nutrient cycling. The pathway by which nutrients are delivered back into the soil (nutrient cycling) is of high importance to a functioning system. Release of nutrients by mineralization of soil organic matter is important in short-term nutrient cycling, but in the long run the organic matter and the nutrients it contains must be replenished or soil fertility will be depleted (Brady and Weil 2008).

Substantial portions of the alpine and tundra ecological response unit are considered inherently unstable soils (unsuited soil condition). Inherently unstable soils are those whose geologic formation and geomorphic properties are naturally active, and soil erosion has existed historically and will continue. Approximately 64 percent of the total area of the alpine and tundra ecological response unit on the Carson is rated in unsuited soil condition. Soil erosion hazard influences soil condition: an inherently unstable soil is more vulnerable to soil condition impairment than an inherently stable soil.

Maintaining satisfactory soil condition is essential for ecological sustainability and long-term soil productivity. Unsatisfactory soil condition (44 percent of Carson NF) reduces the ability and potential of the soil to grow plants and sustain productive, diverse vegetation. Focused restoration treatments and very long periods of recovery time would be needed to return these soils to a productive state (USDA FS 2013c).

Past Management Impacts on Soil Condition

Historically (pre-European settlement) and without anthropogenic (human-caused) disturbances, soil loss, soil compaction, and nutrient cycling would probably have been within functional limits to sustain soil function and maintain soil productivity for most soils that are not inherently unstable. The exception would have been during cyclic periods of drought and possibly localized areas impacted through native human populations and non-domestic animal herbivory. Natural floods would have had a limited effect on the extent of soil loss, only causing accelerated erosion adjacent to stream channels or floodplains. Natural fires, in ecological response units known to typically experience mixed- or high-severity fire, would have had a limited effect on the extent of soil loss, only causing accelerated erosion in localized areas where total consumption of the litter layer or canopy occurred. Drought may have reduced the amount of protective vegetative ground cover resulting in accelerated erosion during prolonged rainstorms.

Much of the current soil condition is related to past management on the Carson NF. Soil condition is affected by activities that occur or re-occur at the same place over time. Permanent loss of soil productivity has and still could affect the level of goods and beneficial uses available from the Carson in the future. Management activities that may have affected soil condition include timber harvesting, prescribed fires, road construction

and use, recreation facility construction, recreation use, and livestock grazing. Some examples of impacts that have affected current soil condition include the following:

- Heavily compacted soils from forest restoration treatments, grazing, and recreation activities have caused or may cause reduced soil productivity for decades (Burger et al. 2010).
- Land-disturbing activities, such as timber harvesting, road construction, and facility construction caused erosion of topsoil at rates greater than the soil's natural ability to replace it (soil loss tolerance rate) resulting in the permanent loss of soil productivity (Renard et al. 1997).
- From 1902 to 1987, as more livestock numbers and acres were grazed, range condition (and associated soil condition) declined; and as fewer number of livestock and acres were grazed, range condition improved.
- According to Gori et al. (2007) livestock and large wildlife grazing removed fine fuels needed to carry surface and mixed-severity fires that likely maintained the more open structure and composition of piñon-juniper savannas and shrub woodlands historically.
- Road corridors that make up the Carson's road system resulted in loss of soil productivity.
- Mineral extraction pits and mines resulted in permanent loss or reduction in soil productivity.
- Uncharacteristic wildfire resulted in erosion rates well beyond tolerance erosion rates.
- Footprints of administrative and recreation sites (both developed and heavily used dispersed sites) have reduced soil productivity.
- Permanent special use sites, such as communication towers and buildings eliminated soil productivity.

There are activities that have improved soil condition and have reduced risk to soil productivity, such as:

- Prescribed fire has removed fuels and undesirable plant material which impede vegetation growth and condition.
- Dense forest, woodland, and invaded grassland canopy treatments have reduced light and water competition and allowed for desired understory grasses and shrubs to re-establish.
- Channel restoration projects have restored bank and vertical stream bed stability, and have re-established groundwater table levels that result in increased vegetation (growth and diversity) and soil productivity.
- Closure of maintenance level 1 roads and decommissioning or removal of unneeded roads has resulted in revegetation of old roadbeds.

Environmental Consequences for Soil Resources

Methodology and Analysis

This section describes the methodology and analysis processes used to determine the environmental consequences on soil condition from implementing the alternatives. Environmental consequences are not site-specific at the broad planning level and are described with qualitative descriptions supported by past studies and observations.

The forest has a limited capacity, in the anticipated 15-year lifespan of the revised plan to reverse trends in all vegetation types, and move them all toward desired conditions. Limitations are imposed by insufficient and fluctuating funding, current lack of a market for small-diameter biomass to offset treatment costs, and the length of time required to accomplish and approve planning of treatments.

Acknowledgement of limited capacity necessitated the identification of resources most at risk of not being sustainable to focus efforts during the planning period. Two focus areas developed during the assessment of current conditions and trends specifically related to soil conditions include:

1. Restore frequent fire ecosystems. Fire dependent ecosystems (ponderosa pine and mixed conifer-frequent fire) are the most highly departed ecosystems on the forest. The lack of fire has led to closed canopies, increased fuel loads, and stressed vegetation.
2. Improve grasslands and herbaceous cover. Grasslands and other ecological response units have experienced dramatic reductions in grass cover and productivity. The lack of grass and herbaceous cover has influenced accelerated erosion and declining soil productivity forestwide for many vegetation communities.

This qualitative analysis describes the current soil condition and projected trends in soil condition by alternative. It also describes the potential effects associated with management activities that could affect soil condition.

Soil condition is based on the primary soil functions of soil hydrology, soil stability, and nutrient cycling as described by technical guidance (USDA FS 2013c). The current soil condition rating is described in the Terrestrial Ecosystem Survey of the Carson National Forest (USDA FS Carson NF 1987) and based on how departed soils are from the historic range of natural variability. The projected trends in soil condition were based on estimates of vegetative ground cover, soil productivity, and organic matter. Each vegetation community (ecological response unit) was examined to see whether soil conditions would generally trend toward, away, or remain static with the implementation of treatments by alternative. The analysis is based on the Vegetation Dynamics Development Tool modeling results for each vegetation community using the range of acres proposed to be treated by alternative and estimates of soil cover and organic matter retention.

Indicators

Soil Condition

Existing soil condition is assessed, and projected trends in soil condition are predicted by alternative and identified plan components.

Indicators Used: Changes in soil condition are impacted by acres treated and by the ability of management objectives to meet or move toward desired conditions according to alternative. Many factors are considered in the determination of soil condition trend. Both the amount and type of ground cover play a large role in soil condition. Ground cover affects soil functional elements by providing resistance to soil erosion and enhancing nutrient cycling and water infiltration by decreasing overland flow rates. A major consideration in predicting ground cover conditions is to compare the current departure of existing vegetative conditions and model predictions to see whether vegetative conditions are moving toward desired conditions, away, or remain static. Ground cover conditions that fall within desired conditions for vegetation generally reflect satisfactory soil ground cover conditions. Soil condition is based on three soil functions including (1) the ability of the soil to resist erosion, (2) the ability of the soil to infiltrate water, and (3) the ability of the soil to recycle nutrients. Vegetative ground cover and herbaceous understory are indicators to determine soil condition.

Stressors

Land-use practices affect soil functions, and these functions are intertwined, making it difficult to discuss them separately. Management actions such as timber harvesting, road management, fuel management, recreation, and grazing can have negative effects including compaction, erosion, and loss of organic matter; all of which can impair the majority of soil functions. While these effects have not been eliminated in current practices, the Carson has decreased these types of effects substantially. This reduction of negative effects, coupled with soil restoration activities, may increase the capacity of soils to support multiple uses and provide ecosystems services over the long term.

The relationship between soil and climate change is interconnected. First, climate change may affect the soil resource. In return, soils have the ability to either store or release greenhouse gases; thereby, potentially

influencing climate change. The potential impacts of climate change on the forest soil resource are not well known at this time. Warmer winters may result in large areas where winter operations are constrained by poor road conditions. Increased frequency and severity of summer droughts could threaten vegetation cover through increased wildfires, and pathogen and insect activity. Loss of biomass carbon will affect soil organic carbon, carbon sequestration, and the nutrient cycling process.

Assumptions

In the analysis of soils, the following assumptions have been made:

- The alternatives are compared using the average (mid-point) treatment level.
- Soil and Water Conservation Practices (best management practices) would be applied to all management activities as described in FSH 2509.22.
- Data used in this analysis represent forestwide conditions and may not represent soil condition at any given point on the landscape. It is important to realize that many differences in soils and related disturbances can occur within short distances. Overall accuracy of mapping and information provided by the Terrestrial Ecosystem Survey and soil condition protocol is considered reliable at the ecological unit or landscape level. However, on-site inspection should be conducted for site-specific project assessments.
- On the Carson, the first major component or ecological type of each terrestrial ecosystem map unit was used in the soil analysis, except when the first component is a miscellaneous area (e.g., rock outcrop, badland, rubbleland, or riverwash). If the first major component of a map unit is a miscellaneous area, then the second major component was analyzed.
- The current departure from desired condition is based on the ground cover (bare soil and litter) departure rates for each ecological response unit.

Environmental Consequences for Soil Resources - Alternative 1

Alternative 1 emphasizes producing timber products; managing quality habitat for Mexican spotted owl and northern goshawk and its prey; providing recreation opportunities to meet demand; and range management. The current plan has no articulated desired conditions for wetlands, seeps and springs, or various riparian ecosystems. It does not recognize the traditional communities and uses that occur on the Carson and does not reflect changes in economic, social, and ecological conditions, new policies and priorities, and new information based on monitoring and scientific research. Since this alternative reflects no change in current management, no additional wilderness is recommended. This alternative provides a baseline for estimating the effects of the other alternatives.

Management of the soil resource would continue in accordance with forestwide and management area specific goals, objectives, standards, and guidelines in the existing plan. The existing plan establishes a desired condition of satisfactory watershed conditions through direct (streambank stabilization, contour trenching and plowing, obliteration of roads and revegetation of areas with insufficient vegetative ground cover) and indirect (grazing allotment management, off-road vehicle management, and travelway maintenance and management) soil and water improvement methods. The current plan standards and guidelines also require the utilization of soil and water conservation practices (best management practices) to address project-specific mitigation needs to protect the soil resource. All of these practices would have beneficial effects to the ability of the soil to resist erosion, infiltrate water, and recycle nutrients.

Oil and gas development and production currently occurs within the Jicarilla Natural Gas Management Area. The effects of these short- and long-term consequences under alternative 1 could include increased soil disturbance and compaction. Road and well pad construction limitations related to slope would reduce erosion and mass wasting on steep slopes that may otherwise impair long-term soil productivity and watershed conditions. Co-location of pipeline, road, and other infrastructure, road design limitations, and

well siting measures that limit surface disturbance would decrease soil loss and compaction. Avoidance of riparian areas would protect surface waters by reducing the probability for sedimentation along stream channels.

Risk of uncharacteristic fire at the landscape scale is greatest for alternative 1 because the prescribed rate of fuel treatments is less than all other alternatives. Also, the information on which the treatments are based is outdated compared to the other alternatives. Projections indicate that there will likely be recurrent erosion cycles resulting from large wildfires and subsequent damage to the soil resource. Uncharacteristic fire alters vegetation composition and structure. Accelerated erosion results from changes in ground and canopy cover as well as detrimental effects to soil structure due to loss of roots to hold soil particles through cohesion.

Management of the transportation system under alternative 1 does not include sufficient direction to adequately minimize erosion and subsequent sedimentation. It does not contain specific objectives for a forestwide approach to decommission unneeded roads and maintain and repair system roads. Direction for managing the transportation system in areas of highly erodible soils, riparian areas, and wetlands is minimal. Roads are often the main source of sedimentation in a watershed. Improperly located or maintained roads have the highest potential to cause detrimental effects to the soil resource via soil detachment and transportation as sediment to riparian and wetland areas. It must be noted, high-standard forest roads, State, Federal, and county highways and roads are considered a permanent allocation of the soil resource, and no further effect to the soil resource is inferred for those transportation features.

Increased demand for motorized recreation and the proliferation of off-highway vehicles is not adequately addressed under alternative 1. Even though motorized recreation is restricted to roads and trails, the existing plan does not establish desired conditions or guidelines for management of this recreational use where it is permitted that would mitigate and/or avoid compaction, erosion, and vegetation disturbance or loss and subsequent effects on soil and watersheds. This type of use is often a vector for the establishment and expansion of invasive species, and no strategy or guidelines are provided to address the potential for impacts to the soil resource resulting from loss or reduction of natural vegetative communities and replacement by nonnative and invasive plants.

Alternative 1 does not provide direction for management of resources in response to climate change. Without management direction, atypical temperature and rainfall patterns predicted as part of climate change may adversely affect forest soils and the resources they support, such as vegetation, watersheds, and habitat. In the arid Southwest, soil erosion is likely to increase because of climate change, whether as the result of flooding caused by more intense storms or from increased arid conditions resulting from warmer temperatures and drought. Without planning for such changes, increases in direct soil loss in runoff and heavier sedimentation in streams would occur.

Environmental Consequences for Soil Resources – Alternative 2

Alternative 2 is the draft proposed plan and was developed to respond to key issues identified during the assessment. This alternative provides for restoration and diverse ecosystem services. Alternative 2 addresses the need to better recognize and enhance the Carson NF's role in contributing to local economies, including service-based sectors such as recreation and tourism, timber and forest products, livestock grazing, and other multiple-use-related activities and products. Alternative 2 also includes plan direction that allows for adaptive management, to address potential ecological changes that have the potential to alter the provision of ecosystem services from the Carson NF. These include:

- Forested fire-dependent ecosystems are departed and prone to uncharacteristic stand-replacing fire.
- Grassland communities and herbaceous understories are less productive than they were historically.
- Surface water is at risk across much of the forest, due to temperature, turbidity, and degraded riparian and aquatic condition and function.

- The ability of the Carson to remain relevant and responsive to changing recreation user demands is at risk of being unsustainable.
- The ability of the Carson to continue contributing to the social and economic benefits desired by local communities and the visiting public is at risk of being unsustainable.

Alternative 2 proposes roughly 9,189 acres of recommended wilderness and provides for restoration of diverse ecosystem services. Of the four action alternatives, alternative 2 best conserves the soils resource by virtue of its emphasis on restoration of Frequent Fire Forest types through a combination of mechanical treatments, use of prescribed fire, and management of natural ignitions; travel management focused on appropriate use of mechanical and motorized vehicles and equipment; reasonable reduction of the road network through decommissioning, obliteration, or restoration of unneeded and unauthorized routes; active management and maintenance of grasslands; and recommendations for wilderness. Several elements of this proposal may impact soil condition and function and the ability of the soil resource to provide ecological services.

Restoration of Frequent Fire Forest types - Mixed Conifer with Frequent Fire (VEG-MCD-O-1,2) and Ponderosa Pine Forest (VEG-PPF-O-1,2) through both mechanical treatment and a combination of prescribed and naturally ignited fire to move toward desired conditions.

Effects to soil condition and function of the soil resource may occur from mechanical treatments of frequent fire forest types. These effects would likely result in change in hydrologic function (change in bulk density, infiltration, and surface soil structure) from roading, skidding, decking, and brush/slash disposal, decreased soil stability (increased soil erosion) and altered levels of nutrient cycling (groundcover reduction, reduction of coarse woody material). Effects to soil condition and function of the soil resource from use of prescribed fire and management of natural ignitions would also occur. Loss of overstory canopy, reduction of groundcover, heating of surface soils and development of water repellency during fire management (prescribed and natural ignitions) may cause increased levels of soil erosion and reduction of infiltration where uncharacteristic fire intensity occurs.

Restoration of structure and function of non-functioning and functioning at risk riparian areas (WSW-RMZ-O-1).

Improved soil condition and function of the soil resource would occur from riparian area restoration. These effects would likely result in a forestwide increase (positive change) in hydrologic function and soil stability from restoration activities designed to address current head-cutting and stream bank erosion, and improve nutrient cycling by enhancing the amount of riparian and wetland vegetation present within treated areas.

Transportation and Forest Access (TFA)

Improved soil condition and function of the soil resource would occur from transportation and forest access. Obliteration or naturalization of at least 20 miles of routes not identified on the motor vehicle use map (TFA-O-1) would result in positive effects to soil condition and function of the soil resource on those miles obliterated or “naturalized” as compacted surfaces are eliminated, vegetation is restored, and surface runoff and subsequent erosion loss is minimized. These effects would result in an increase (positive change) in hydrologic function and soil stability from road obliteration and/or naturalization within the watersheds and vegetative communities where these actions occur.

Construction of new or temporary roads accompanied by a mitigating action (TFA-G-2) to offset resource damage could also affect soil condition and function of the soil resource. Depending on the ratio of new or temporary road constructed and the length of routes identified and implemented as mitigation, this could be a positive or negative impact on soil condition and soil function. At the least, a 1 to 1 ratio would be needed to effect a positive change in soil condition. Forestwide, effects from new roads proposed in this alternative would partially be offset by mitigation action outlined in this guideline (TFA-G-2). Closure and rehabilitation

of temporary roads that support restoration activities, fuels management, or other short-term projects would also benefit soil condition (TFA-G-7).

Oil and gas development and production currently occurs within the Jicarilla Natural Gas Management Area. The effects of these short- and long-term consequences under alternative 1 could include increased soil disturbance and compaction. Road and well pad construction limitations related to slope would reduce erosion and mass wasting on steep slopes which may otherwise impair long-term soil productivity and watershed conditions. Co-location of pipeline, road, and other infrastructure, road design limitations, and well siting measures that limit surface disturbance would decrease soil loss and compaction. Avoidance of riparian areas would protect surface waters by reducing the probability for sedimentation along stream channels.

Wildland Fire Management (FIRE)

Management of naturally ignited fires (including those in designated areas) to meet multiple resource objectives when fire weather conditions facilitate progress toward desired conditions would improve soil condition where implemented. Many variables can influence effects when managing a natural ignition for multiple resource objectives, including fuel loading, fire behavior, fire intensity, and changing fire weather conditions. Where fire effects are characteristic of the frequent fire forest types (MCD and PPF) removal of overstory, reduction of groundcover, and re-establishment of herbaceous ground vegetation would improve current soil condition and create a fuel complex that would allow recurrent fire to play its role as a needed disturbance agent. Areas of higher fire intensity would see a reduction in soil condition as lack of groundcover and related increased erosion rates would occur and persist for several years post fire.

Recommended Wilderness (MA-RWMA)

Recommendations for wilderness under this alternative would result in neutral to positive effects to soil condition within the 9,189 acres recommended for wilderness evaluation. Grazing of livestock (MA-RWMA-DC-5), with no additional guidelines, would allow any current impacts to soil condition from this activity to continue (e.g., compaction, erosion, loss of organic matter, and shifts in species composition). Existing structures necessary for administration of these areas would be maintained (MA-RWMA-G-5) which would cause temporary, short-term effects to soil condition, intermittently through the life of this plan. For example, if all-terrain vehicles are needed for maintenance, they may cause localized compaction and vegetation disturbance.

Grassland Maintenance Management Area (MA-GMMA)

Maintenance of grasslands converted from stands of piñon-juniper woodland and ponderosa pine forest to a seral condition of native and introduced grass species for forage production would be beneficial to soil condition and function of the soil resource. Current conditions of encroachment of woody species (piñon, juniper, ponderosa pine, and sagebrush) coupled with grazing use by domestic and wild ungulates result in poor groundcover, limited diversity of herbaceous species, large patches of bare soil and reduced hydrologic function and decreased soil stability. Restoring a balance of native and introduced grass species in areas where current herbaceous cover is minimal (MA-GMMA-S-1,2) as well as management of woody encroachment (mechanical/chemical/fire) (MA-GMMA-DC-1) should increase vegetative cover and grass diversity, provide for soil stability and nutrient cycling, and improve hydrologic function of the soil resource.

Environmental Consequences for Soil Resources - Alternative 3

Alternative 3 provides for maximum access and commodity utilization of forest resources and their diverse ecosystem services. Alternative 3, while it increases the pace of forest restoration through mechanical treatment, constrains the use of prescribed fire in restoration and potentially expands the road network by eliminating options to decommission/obliterate/restore un-needed routes and allows for the possibility to increase the road system through conversion of temporary roads utilized for restoration to system roads or

trails. In addition, management of natural ignitions for multiple resource objectives is constrained to areas outside “suitable timber” areas. There are several elements of this proposal that may impact soil condition and function of the soil resource and the ability to provide ecological services.

Restoration of Frequent Fire Forest types - Mixed Conifer with Frequent Fire (VEG-MCD-O-1) and Ponderosa Pine Forest (VEG-PPF-O-1) through increased mechanical treatment.

Effects to soil condition and function of the soil resource may occur from mechanical treatments of frequent fire forest types. These effects would likely result in change in hydrologic function (change in bulk density, infiltration, and surface soil structure) from roading, skidding, decking, and brush/slash disposal, decreased soil stability (increased soil erosion) and altered levels of nutrient cycling (groundcover reduction, reduction of coarse woody material). These impacts would be most likely to occur under alternative 3 where average treatment amounts would increase by three-fold (7,750 acres versus 22,500 acres) in VEG-MCD and two-fold (36,000 acres versus 75,000 acres) in VEG-PPF compared to alternative 2.

Effects to soil condition and function of the soil resource from use of prescribed fire under alternative 3 would be similar to alternative 2 as this management practice would be utilized to move toward desired conditions for Frequent Fire Forest types (VEG-MCD, VEG-PPF). Fire would be infrequent in some areas including suitable timber and near trails where it would generally be suppressed according to FW-FIRE-G-1. Fuels would build up in these places, particularly fire sensitive species such as white fir, leading to a high risk of uncharacteristic wildfire, more difficult fire management, and fire intensities and severities that would be higher than desired. This would increase ground disturbance within suitable timber as mechanical disposal of slash would likely increase over time. Use of prescribed fire to address increased fuel loading would be ineffective or result in fire intensity that would be damaging to soil condition or would cause unacceptable loss or damage to lands with suitable timber.

Management of naturally ignited fires to meet management objectives (FIRE-G-1) would be allowed only in areas outside suitable timber. Naturally ignited fire would be limited to steeper slopes where groundcover and vegetation loss would result in accelerated rates of erosion post fire.

Restoration of structure and function of non-functioning and functioning at risk riparian areas (FW-WSW-RMZ-O-1)

Effects would be the same as under alternative 2 described above. Improved soil condition and function of the soil resource would occur from riparian area restoration. These effects would likely result in a forestwide increase (positive change) in hydrologic function and soil stability from restoration activities designed to address current head-cutting and stream bank erosion, and improve nutrient cycling by enhancing the amount of riparian and wetland vegetation present within treated areas.

Transportation and Forest Access (TFA)

Improved soil condition and function of the soil resource would not occur from transportation and forest access under alternative 3. There are no objectives for obliteration or naturalization of routes not identified in the motor vehicle use map (TFA-O-1). While some may still occur as opportunities arise, total positive effects to soil condition and function of the soil resource on those miles obliterated or naturalized would be less than under any other alternative. Compacted road/route surfaces would persist, less vegetation cover would be restored, and current surface runoff and subsequent erosion loss would continue unabated. There would still be positive soil impacts from routine maintenance activities of open roads. These effects would result in a decrease (negative change) in hydrologic function and soil stability from road use, miles of system roads, miles of non-system routes, and temporary roads developed for mechanical vegetation treatments within the watersheds and vegetative communities where this action occurs.

Construction of new or temporary roads un-accompanied by a mitigating action (TFA-G-3) to offset resource damage and future consideration for conversion of these new road features into system roads or motorized trails would also affect soil condition and function of the soil resource. Forest motorized access would be

increased, increasing the burden of road maintenance on system roads, and likely increasing the total land area converted to roads/routes/trails to an extent that hydrologic function would be impaired, and soil stability diminished by increased erosion and sedimentation to aquatic environments.

Oil and gas development and production currently occurs within the Jicarilla Natural Gas Management Area. The effects of these short- and long-term consequences under alternative 1 could include increased soil disturbance and compaction. Road and well pad construction limitations related to slope would reduce erosion and mass wasting on steep slopes which may otherwise impair long-term soil productivity and watershed conditions. Co-location of pipeline, road, and other infrastructure, road design limitations, and well siting measures that limit surface disturbance would decrease soil loss and compaction. Avoidance of riparian areas would protect surface waters by reducing the probability for sedimentation along stream channels.

Wildland Fire Management (FIRE)

Management of naturally ignited fires (including those in designated areas) to meet multiple resource objectives when fire weather conditions facilitate progress toward desired conditions would improve soil condition where implemented. Many variables influence effects when managing a natural ignition for multiple resource objectives, including fuel loading, fire behavior, fire intensity, and changing fire weather conditions. Where fire effects are characteristic of the frequent fire forest types (MCD and PPF) removal of overstory, reduction of groundcover, and re-establishment of herbaceous ground vegetation would improve current soil condition and create a fuel complex that would allow recurrent fire to play its role as a needed disturbance agent. Areas of higher fire intensity would see a reduction in soil condition as lack of groundcover and related increased erosion rates would occur and persist for several years post fire. Suppression of all natural ignitions in suitable timber and areas where managed fire could affect trails would reduce the scale and scope of this management activity and rely on mechanical treatments solely to effect change to current conditions in MCD and PPF communities.

Grassland Maintenance Management Area (MA-GMMA)

Effects would be the same as under alternative 2 described above. Maintenance of grasslands converted from stands of piñon-juniper woodland (PJO) and ponderosa pine forest (PPF) to a seral condition of native and introduced grass species for forage production would be beneficial to soil condition and function of the soil resource. Current conditions of encroachment of woody species (piñon, juniper, ponderosa pine, and sagebrush) coupled with grazing use by domestic and wild ungulates result in poor groundcover, limited diversity of herbaceous species, large patches of bare soil and reduced hydrologic function and decreased soil stability. Restoring a balance of native and introduced grass species on areas where current herbaceous cover is minimal (MA-GMMA-S-1,2) as well as management of woody encroachment (mechanical/chemical/fire) (MA-GMMA-DC-1) should increase vegetative cover and grass diversity, provide for soil stability and nutrient cycling, and improve hydrologic function of the soil resource.

Off-Highway Vehicle Management Area (OHVMA)

Designation of cross-county travel opportunities (MA-OHVMA-DC-1) to provide challenging terrain for motorcycle and off-highway vehicle use would directly affect soil condition within the bounds of trails or areas designated for this use. Creating or increasing the amount of bare soil exposed and vegetation damage or loss along a limited trail and road system (MA-OHVMA-DC-2) designated for this use would increase soil erosion and possibly alter hydrologic function within the limited land areas designated for this type of recreational use. Limited impact to soil condition or function of the soil resource would be expected to result from other ancillary features associated with this use such as parking areas, restrooms, etc.

Environmental Consequences for Soil Resources Alternative 4

Alternative 4 provides for maximizing natural processes. Alternative 4 increases the pace of forest restoration but only using prescribed fire and management of natural ignitions. It does not allow for mechanical treatment to meet this restoration objective. It does not focus on forestwide needs for riparian management and restoration. Travel management is focused on appropriate use of mechanical and motorized vehicles and equipment and a reasonable reduction of the road network through decommissioning/obliteration/restoration of unneeded and unauthorized routes. It does not include the Grassland Maintenance Management Area for active management and maintenance of grasslands, and it increases the area recommended for wilderness. There are several elements of this alternative that may impact soil condition and function of the soil resource and the ability to provide ecological services.

Restoration of Frequent Fire Forest types - Mixed Conifer with Frequent Fire (VEG-MCD-O-2) and Ponderosa Pine Forest (VEG-PPF-O-2) through a combination of prescribed and naturally ignited fire to move toward desired conditions.

The use of prescribed fire and management of natural ignitions would have effects on soil condition and function of the soil resource. Loss of overstory canopy, reduction of groundcover, heating of surface soils and development of water repellency during fire management (prescribed and natural ignitions) may cause increased levels of soil erosion and reduced infiltration where uncharacteristic fire intensity occurs.

Transportation and Forest Access (TFA)

Improved soil condition and function of the soil resource would occur from transportation and forest access. Obliteration or naturalization of at least 40 miles of roads not identified in the motor vehicle use map (TFA-O-1) would result in positive effects to soil condition and function of the soil resource on those miles obliterated or naturalized as compacted surfaces are eliminated, vegetation is restored, and surface runoff and subsequent erosion loss is minimized. These effects would result in an increase (positive change) in hydrologic function and soil stability from road obliteration and/or naturalization within the watersheds and vegetative communities where these actions occur.

Construction of new or temporary roads accompanied by a mitigating action (TFA-G-3) to offset resource damage could also affect soil condition and function of the soil resource. Depending on the ratio of new or temporary road constructed and the length of roads identified and implemented as mitigation, this could be a positive or negative impact on soil condition and soil function. Road construction would result in removal of vegetative cover, soil disturbance and compaction, and increased sedimentation, while decommissioning would restore vegetative cover, alleviate surface compaction, and reduce long term sedimentation. At the least, a 1 to 1 ratio would be needed to effect a positive change in soil condition. Forestwide, effects from new roads proposed in this alternative would partially be offset by mitigation action outlined in this guideline (TFA-G-2). Closure and rehabilitation of temporary roads that support restoration activities, fuels management, or other short-term projects would also benefit soil condition (TFA-G-4) by restoring vegetative cover, alleviating surface compaction, and reducing long term sedimentation.

Oil and gas development and production currently occurs within the Jicarilla Natural Gas Management Area. The effects of these short- and long-term consequences under alternative 1 could include increased soil disturbance and compaction. Road and well pad construction limitations related to slope would reduce erosion and mass wasting on steep slopes which may otherwise impair long-term soil productivity and watershed conditions. Co-location of pipeline, road, and other infrastructure, road design limitations, and well siting measures that limit surface disturbance would decrease soil loss and compaction. Avoidance of riparian areas would protect surface waters by reducing the probability for sedimentation along stream channels.

Wildland Fire Management (FIRE)

Effects would be the same as alternative 2 described above. Management of naturally ignited fires (including those in designated areas) to meet multiple resource objectives when fire weather conditions facilitate progress toward desired conditions would improve soil condition where implemented. Many variables can influence effects when managing a natural ignition for multiple resource objectives, including fuel loading, fire behavior, fire intensity, and changing fire weather conditions. There would be less mechanical reduction of fuel loading and fires would be more likely to burn with uncharacteristically high severities. Compared to alternative 2, it would be more difficult to attain fire effects characteristic of the frequent fire forest types (VEG-MCD and VEG-PPF). There would be less removal of overstory, more groundcover, less re-establishment of herbaceous ground vegetation, and fewer areas with improved soil condition. Areas of higher fire intensity would be more common and would see a reduction in soil condition as lack of groundcover and related increased erosion rates would occur and persist for several years post fire.

Recommended Wilderness (MA-RWMA)

Recommendations for wilderness under this alternative would result in neutral to positive effects to soil condition within the 45,473 acres recommended as wilderness. There would be fewer impacts from illegal motorized use and mechanical vegetation management such as soil disturbance or compaction. Grazing of livestock (MA-RWMA-DC-5), with no additional guidelines, would allow any current impacts to soil condition from this activity to continue (e.g., compaction, erosion, loss of organic matter, and shifts in species composition). Existing structures necessary for administration of these areas would be maintained (MA-RWMA-G-5) which would cause temporary, short-term effects to soil condition, intermittently through the life of this plan. For example, if ATVs are needed for maintenance, they may cause localized compaction and vegetation disturbance.

Environmental Consequences for Soil Resources Alternative 5

Alternative 5 provides for restoration of diverse ecosystem services and proposes 67,996 acres (100 percent) of evaluated areas as recommended wilderness.

Conservation of the soil resource under alternative 5 would be similar to alternative 2. This alternative is essentially identical to alternative 2 but with more area of land recommended for wilderness. Those additional acres of recommended wilderness are the sole difference between the two alternatives in terms of best meeting objectives related to soil condition and function of the soil resource to provide ecological services expected by the public. Effects of alternative 5 are the same as alternative 2 described above with the following distinction.

Recommended Wilderness (MA-RWMA)

Recommendations for wilderness under this alternative would result in neutral to positive effects to soil condition within the 67,996 acres recommended for wilderness evaluation. There would be fewer impacts from illegal motorized use and mechanical vegetation management such as soil disturbance or compaction. Grazing of livestock (MA-RWMA-DC-5), with no additional guidelines, would allow any current impacts to soil condition from this activity to continue (e.g., compaction, erosion, loss of organic matter, and shifts in species composition). Existing structures necessary for administration of these areas would be maintained (MA-RWMA-G-5), which would cause temporary, short-term effects to soil condition, intermittently through the life of this plan. For example, if ATVs are needed for maintenance, they may cause localized compaction and vegetation disturbance.

Cumulative Environmental Consequences for Soil Resources

Although the soil resource is managed by the Carson primarily within the boundaries of the forest, its function and productivity can be affected by activities and natural processes that originate beyond those boundaries or from private or other public inholdings surrounded by NFS land. Cumulative effects of

multiple activities in the same area, such as within a watershed, depend upon the intensity of the activity and condition of the baseline environment.

Past, present, and future actions on the forest that contribute cumulatively to soil conditions include (1) ground-disturbing actions, including road, timber management and harvest, (2) grazing, (3) nonnative species proliferation, and (4) wildfire. The types of effects associated with these activities were discussed above under the effects of the alternatives. Site-specific evaluations of cumulative soils impacts will be done on a case-by-case basis during future environmental analyses of individual projects.

Potential additive effects on soils in watersheds are possible during the life of the revised plan. All 4th-, 5th-, and 6th- hydrologic unit code watersheds, even those that are only partially on National Forest System lands, are within the area of potential effect. Generally, the upper portions of watersheds are managed by the Carson and lower-lying areas along valley floors are managed by private landowners interspersed within the forest boundary.

Private and public land development within and outside the national forest boundary disturbs and removes soils and vegetation, increasing erosion and sediment runoff to streams and other waterbodies. With population growth in the area, the upward trend in land development is expected to continue. In conjunction with growth, more people use the national forest, driving and parking more vehicles in unpaved areas, causing soil compaction and vegetation damage which, in turn, affects soil function and productivity.

Other activities on private land such as road building, grazing, mining, and fuel treatments may remove or disturb vegetation and soils and increase sediment in surface waters, affecting stream quality and aquatic habitat. All of these actions, individually or in combination, may contribute to cumulative effects on the soil resource on and outside of the Carson NF.

Watersheds and Water

Description of Affected Environment

Watersheds

A watershed (drainage basin) is a region or land area drained by a single stream, river, or drainage network (36 CFR 291.19). All of the watersheds in the United States are classified in a nested arrangement of hydrologic units from largest to smallest and are identified with hydrologic unit codes. The largest unit of scale is called a region (level 1 hydrologic unit; (Seaber et al. 1987). Sub-regions (level 2 hydrologic unit), basins (level 3 hydrologic unit), sub-basins (level 4 hydrologic unit), watersheds (level 5 hydrologic unit), and sub-watersheds (level 6 hydrologic unit) are nested within each other, and within regions. Watersheds each encompass about 250,000 acres; sub-watersheds each encompass approximately 40,000 acres. For this analysis, the scale of sub-watersheds is used. The smallest delineated areas used in the Carson plan are 6th code sub-watersheds (hydrologic unit code 12) which range in size from about 10,080 to 40,404 acres. The Carson intersects 131 6th code sub-watersheds (hydrologic unit code 12).

Watershed Condition

Watershed condition is a term that describes the ability of a watershed system to receive and process precipitation without ecosystem or hydrologic degradation (Brooks et al. 2003). It is the state of the physical and biological processes within a watershed; these processes affect soil condition and hydrologic function, which in turn support ecosystems. Watershed condition can be represented by a continuum from naturally pristine to degraded. Naturally pristine indicates the watershed characteristics (e.g., soil condition, ground cover, etc.) which capture, store, and release water, sediment, wood, and nutrients function so as to ensure these processes occur at rates similar to those in undisturbed, natural systems. Where they do, watersheds create and sustain functional terrestrial, riparian, aquatic, and wetland habitats capable of supporting diverse populations of native species.

Water Resources

Surface Water

Surface water on the forest is fed primarily by snowmelt (both snowmelt runoff in the spring and early summer and groundwater inputs due to recharge from melting snow). On average, surface runoff peaks in May–June during maximum snowmelt and decreases through the summer.

Although most annual peak flows occur during May or June, the largest floods on record have often occurred during summer monsoonal rains when rainfall intensity exceeds the rate at which soils absorb moisture (especially following high-severity wildfires). Within drier portions of the forest, many smaller tributary channels have their largest floods during intense summer thunderstorms. These thunderstorm-induced floods tend to affect specific water features, due to intense local rainfall under a thunderstorm cell. Some ephemeral streams in the more arid portions of the forest may only flow once every few years during intense thunderstorm precipitation. Precipitation from summer thunderstorms also helps to maintain base stream flows.

A forest-wide detailed analysis of present-day water yield has not been conducted. Water quantity is a function of both climate and watershed condition. Reference levels of water yield are also unknown; however, research suggests that water yield in pre-settlement, open-canopied ponderosa pine forests was higher than in the closed-canopy forests (with larger evapotranspiration rates) prevalent today (Covington and Moore 1994). In addition to changes in forest condition, recent climatic drought conditions and the resultant decline in winter and summer precipitation have contributed to decreased water storage, runoff, and yield. The current drought in northern New Mexico began in spring 1996, following several years of above-average temperature and was exacerbated by subsequent below-average precipitation and continued heat. Stream gauge data from across the forest reflects this same drop in available water. All areas have significantly reduced flow. On average, streamflow has declined by 20 percent from pre-1996 levels (USDA FS Carson NF 2015a; USGS 2014).

Surface water on the Carson NF includes streams, reservoirs, lakes, wetlands, stock ponds, seeps, and springs. These features provide habitat for diverse communities of vegetation, wildlife, and fish, as well as provide water for downstream uses that include crop irrigation, domestic livestock, municipal and domestic water supplies, commercial, industrial, and other uses.

Water Quality

The quality of water within the Carson is generally high, and water is used both on and off forest for many purposes. Designated uses include (but are not limited to) domestic water supply, municipal water supply, primary contact (e.g., swimming), secondary contact (e.g., fishing, boating), wildlife habitat, livestock watering, cold water habitat, and irrigation (USDA FS Carson NF 2015a).

There are 1,044 miles of perennial streams on the Carson. Of the 131 streams assessed, portions of 56 perennial streams are not in full attainment of water quality. As reported in the 2016–2018 State of New Mexico Clean Water Act Section 303(d)/303(b) Integrated report (NMED 2016), the most common cause of impairment is high water temperature as a result of reduced shading and/or reduced stream flows due to drought or water diversion. High turbidity nutrient/eutrophication biological indicators, and *E. coli* are also common causes of impairment of streams on the forest. High water temperature impairment is reported on 218 miles of streams. Turbidity, sedimentation, and specific conductance account for the second largest cause of water quality impairment, affecting 156 miles of streams. Turbidity and sedimentation often result from degraded upland vegetative conditions or roads and trails in poor condition.

There are 1,565 waterbodies on the Carson totaling over 1,308 acres. The national forest has a significant role in maintaining the integrity of waterbodies especially in the Rio Chama and Upper San Juan basins (USDA FS Carson NF 2015a).

There are 659 documented seeps or springs on the Carson NF. Springs and seeps occur where groundwater emerges on sloping terrain, toe-slope breaks, and geologic formation transition zones. Many springs on the forest flow almost constantly throughout the year, though flows can vary from year-to-year. The forest has developed approximately 597 springs for livestock and wildlife use (USDA FS Carson NF 2015a).

Groundwater

The Carson is an important source of groundwater recharge. All groundwater in northern New Mexico originates as infiltrating precipitation. Surface water from each basin supplies both shallow and deep geologic aquifers.

Groundwater and surface water are interdependent in almost all ecosystems. Groundwater plays significant roles in sustaining the flow, chemistry, and temperature of streams, lakes, springs, seeps, and wetlands (Winter et al. 1998). Many communities around the Carson National Forest are heavily reliant on it, as are groundwater-dependent ecosystems (USDA FS Carson NF 2015a, US EPA 2013).

Environmental Consequences for Watersheds and Water

Methodology and Analysis

This section describes the methodology and analysis processes used to determine the environmental consequences by each alternative on watershed and water resources. Environmental consequences are not site-specific at this planning level. The specific location, design, and extent of future actions are generally not known or addressed. This discussion refers to the potential for consequences to occur based on the kinds of resource management activities allowed under the plan. Environmental consequences are useful for comparing and evaluating alternatives at a programmatic level and are described qualitatively, supported by past studies and observations.

Watershed Condition Framework

The watershed condition framework, an analysis methodology developed by the Forest Service, classifies the state of all NFS watersheds and provides guidance to help national forests evaluate, prioritize, and measure the progress of restoration within watersheds (USDA FS 2011b, 2011c). Of the 131 sub-watersheds intersecting the Carson, 111 sub-watersheds were classified using the watershed condition framework in 2010. The remaining 20 have less than 5 percent of their total acreage within the forest boundary and they were not classified. Sub-watersheds were classified as one of three condition categories:

- Class 1 (properly functioning) – Watersheds exhibit high geomorphic, hydrologic, and biotic integrity relative to their natural potential condition and they are functioning properly.
- Class 2 (functioning at risk) – Watersheds exhibit moderate geomorphic, hydrologic, and biotic integrity relative to their natural potential condition and they are functioning, but at risk.
- Class 3 (impaired function) – Watersheds exhibit low geomorphic, hydrologic, and biotic integrity relative to their natural potential condition and their function is impaired.

Sub-watersheds are placed into these condition classes using analysis metrics within the following indicator groups: aquatic physical, aquatic biological, terrestrial physical, and terrestrial biological. Watersheds with characteristics (and hydrologic processes) closer to their naturally pristine state are likely to be “properly functioning,” whereas, those that have been severely altered are more likely to be degraded (resulting in impaired function). Beyond simply assessing watershed condition, the watershed condition framework is used to identify priority watersheds, areas where land management decisions should emphasize maintaining or improving watershed condition.

Assumptions

Assumptions Unique to Watersheds and Water Resources

- The various watershed restoration activities described in the plan will occur at the extent necessary to achieve the objectives described by each alternative. The specific locations and designs of these activities are not known at this time. Therefore, this analysis refers to the potential of effects to occur, realizing that in many cases, these are only estimates.
- The actual rates of watershed condition improvement are dependent on funding and support by Forest Service leadership and collaborators.
- Water conservation practices (best management practices) will be implemented during all management activities
- Some resources (e.g., groundwater) are not within the agency's authority to control; these will be noted.
- Conditions described in this analysis are generalized forest-wide and may not represent water quality or flow conditions at any specific location.

Spatial and Temporal Bounds of Analysis

The environmental consequences to both watersheds and water resources (surface and groundwater) will be analyzed within a 15-year timeframe (same as the planning period). The spatial bounds of these analyses are the 131 (12-digit hydrologic unit code) sub-watershed boundaries that overlap the Carson National Forest administrative boundary.

Indicators and Measures

Effects Indicators

Effects indicators are used as proxies by which to measure an action's impacts (beneficial and adverse; direct, indirect, and cumulative) on the environment. Because this analysis is programmatic (not site-specific) and the alternatives will direct future Carson management activities, appropriate effects indicators are plan-guided management actions likely to affect watersheds and water resources:

- Restoration activities
- Developed recreation sites/trail improvements
- Livestock grazing activities
- Road maintenance/construction/decommissioning

Drivers and Stressors

A stressor is an environmental condition, external stimulus, or event (apart from a direct management action) that strains the ability of watershed processes to function within their historic range of variability. Watershed processes include the physical actions between a precipitation event and the residence of that water within a basin. For example, infiltration and runoff, sediment transport, wood entrainment, and nutrient routing from hillslopes through a channel network are all important watershed processes (Naiman 1992). These processes are heavily influenced by the condition and type of vegetation, ground cover, soil, and riparian vegetation within the watershed. Stressors can act directly on hydrologic processes (e.g., drought), or indirectly on watershed conditions (e.g., ground cover) to affect watershed function. Major stressors to water resources include drought and high-severity wildfire. Climate change exacerbates the effects of these stressors.

One characteristic of climate change in northern New Mexico is drought. Streamflow data is available for some gauging stations on or near the forest with periods of record dating as far back as 1914. While human

activity undoubtedly influenced streamflow prior to that time, the 100-year record provides a good baseline for comparison to current conditions. The most conspicuous recent indicator of drought in northern New Mexico began in the spring of 1996 (SCCSC 2013) following several years of above-average temperatures and was exacerbated by subsequent below-average precipitation. Stream gauge data from across the northern mountains of New Mexico reflects this same drop in available water. An analysis of streamflow data from several USGS gauge stations in the southern Sangre de Cristo Mountains showed an average flow reduction of 20 percent from 1996 (drought initiation) through 2013, and an average snowmelt runoff duration that was reduced by 12 days (USGS 2014). Overall, there has been less water available in recent years, both in terms of the annual total and the springtime snowmelt pulse.

In the broader Four Corners region, records show snowpack has been declining since the 1950s (US EPA 2016). Diminished snowpack in this area has serious implications for the streams that support beneficial uses to communities around the Carson. Losing a portion of these major water sources will make communities more reliant on the dwindling supply from local headwater streams and groundwater recharge originating in the Carson.

Water yield from the Carson is a function of both climate (precipitation) and watershed condition. Watershed condition is affected by drought through increased vulnerability of forests to insects and disease, increased fire risk (on average, more than 2 percent of the land in New Mexico has burned per decade since 1984) (US EPA 2016), desiccated soils, reduced ground cover, and reduced riparian function. In general, these effects reduce the holding capacity of watersheds causing them to release water faster (Moody and Martin 2001), in turn reducing the perennial supply of water in rivers downstream. Regionally, most of the major river systems in the southwestern U.S. are expected to experience reductions in streamflow and other limitations to water availability in the future (Garfin et al. 2013).

While the supply of water in and around the Carson is likely to diminish, the demand is likely to increase. As climate change continues to bring warmer temperatures, water loss to the atmosphere (through evapotranspiration and soil desiccation) will rise. Forests and farmlands will, thus, need more water to survive.

Exacerbating this problem, less precipitation is falling as snow, diminishing mountain snowpack. In northern New Mexico, the snowpack is an essential natural reservoir that historically released its water during late spring and early summer. Today, spring melting is occurring earlier in the year; the Colorado River, Rio Grande, and several other southwestern rivers have hydrographs that peak earlier, suggesting that the spring temperatures in these regions are warmer than in the past (US EPA 2016).

Environmental Consequences for Watersheds and Water Common to All Alternatives

Climate

Changes in water distribution, timing of precipitation, availability, storage, watershed management, and human water uses may present some of the most important climate change challenges to management of the Carson NF. The most likely future for the Southwest is a substantially drier one with an increasing probability of drought. Increasingly scarce water supplies will demand tradeoffs among competing uses and potentially lead to conflict (USDA FS 2010c). The combined effects of natural climate variability and human-induced climate change could result in a challenging combination of water shortages for the region (Karl et al. 2009). Some studies predict water shortages and lack of storage capabilities to meet seasonally changing river flow, as well as transfers of water from agriculture to urban uses, as critical climate-related impacts to water availability (Barnett et al. 2008). Without upland reservoirs and with potentially less-productive watersheds, alternative water sources, water delivery systems, and infrastructure support for agriculture would need to be developed (Lenart 2007). A drier climate is very likely to decrease water supplies and increase demand for such uses as recreation, aquatic habitat, and power; thus, increasing competition for decreasing supply (Joyce and Aber 2001).

The timing and extent of storm-related precipitation will play a key role in determining the degree to which people and the environment are affected (USDA FS 2010c). Flash flooding occurring after extended drought may increase the number and severity of floods and accelerate rates of soil erosion. The potential for flooding is very likely to increase because of earlier and more rapid melting of the snowpack with more intense precipitation.

Groundwater

The majority of groundwater withdrawals in central northern New Mexico occur on lands outside the Carson and therefore the Forest Service has no influence on their control. Forest Service groundwater policy (Forest Service Manuals 2560, 2880) as well as agency technical guides, provide direction for well drilling and pumping on the Carson, specifying that these activities must not adversely affect connected riparian habitat and water quantity and quality. Because direction in the Forest Service manual is considered adequate and groundwater withdrawal is governed by State regulations, groundwater management is consistent across all alternatives and is not analyzed in this environmental impact statement.

Riparian Management Zones

One third of all riparian vegetation on the Carson is contained within private inholdings, where the forest does not control management (USDA FS Carson NF 2015a). Impacts to riparian systems in these areas are expected to continue or intensify, including impacts from water extraction and impoundments for agriculture or other uses; impacts (runoff and sedimentation) from agriculture, grazing or other private land development; impacts (reduction of ground cover and bank destabilization) from livestock grazing; and impacts from the conversion of wetlands to other uses. Restoration of riparian areas would improve watershed function by slowing water movement, recharging aquifers, and improving wildlife habitat. Where riparian systems are restored along streams, they dissipate stream energy, and regulate sedimentation, erosion, and pollution, and thus, play a role in water quality.

Livestock Grazing Activities

As of November 2014, the Carson permits 94,381 head months of cattle and sheep on the six ranger districts. There are over 300 actual permitted users who could operate on the national forest. Currently, 179 permits are issued to individuals and 16 are issued to grazing associations. The upper limits for any permittee on the Carson are 400 cattle and 3,000 sheep.

Daily water intake for a beef cow may vary from 3 to 30 gallons per day depending on age, body size, stage of production, and the environment (Rasby and Walz 2011). Where numerous cattle are drinking from surface water sources (within the riparian zone or out of a trough in the uplands), their consumption represents a significant decrease in available water to stream channels, riparian vegetation, wildlife, and humans. Depending on the stocking rate, consumption of water by cattle from springs and stream channels on a single Carson allotment can have a significant effect in the form of decreased available water every day that livestock are present.

Livestock grazing can also adversely and directly affect water quality (Armour et al. 1991). Where animals concentrate at stream channels and springs, they are most likely to contaminate surface waters. The majority of livestock-generated pollution is related to soil disturbance and erosion. Soil becomes compacted in areas where livestock habitually congregate. Compacted soil is less hospitable to plant roots than un-compacted soil. Where roots are unable to penetrate the soil they are less able to take in nutrients and water, making plants more vulnerable to toppling, disease, and drought, as well as decreasing bank strength (Abernethy and Rutherford 2001), causing streams to become more susceptible to erosion.

Livestock hooves and body weight alone easily collapse and otherwise erode stream banks as they trail along, cross, and drink from streams. Soil can be dislodged by hoof action where the ground is moist and sloped (Warren et al. 1986). The loosened soil becomes entrained during precipitation and high flows,

contributing to turbidity and sedimentation. Significant contributions of sediment to a channel can disrupt the delicate balance between incision and aggradation, adversely affecting aquatic and riparian habitats.

Through their feces and urine livestock contribute nutrients and organic matter (Sheffield et al. 1997), bacteria (e.g., *Escherichia coli*) (Davies-Colley et al. 2004), and protozoan pathogens (e.g., *Giardia*) (Nader et al. 1998) to stream channels. Nutrient addition to surface waters, particularly phosphorus and nitrogen, can increase algal growth, decrease water clarity, and increase ammonia concentrations, which can be toxic to fish. The increased organic matter also serves as a food source for bacteria and other microorganisms, resulting in lower oxygen levels in the water. Bacteria and protozoan pathogens can be harmful to humans and wildlife.

Livestock grazing can adversely affect stream temperature (Beschta 1997). Where stream channels lack significant vegetative cover due to grazing, solar exposure may warm surface water, harming cold water-dependent aquatic species.

Livestock grazing can adversely affect stream channel form, process, function, and habitat where it has diminished or eliminated woody riparian species (e.g., grey alder, *Alnus incana*; narrowleaf willow, *Salix exigua*; shining willow, *Salix lucida*; yellow willow, *Salix lutea*). As large wood (branches and trunks) from these species accumulates within stream channels, it can have significant beneficial hydraulic effects; providing habitat diversity, dissipating stream energy (reducing stream channel erosion), directing flow, creating areas of scour, and areas of sedimentation (Tabacchi et al. 2000). This diversity is critical to aquatic habitat.

A decrease in woody species in riparian areas due to grazing can also adversely affect baseflows. During flood flows, flexible plants (e.g., willows) protect the stream banks by bending in the current, effectively covering the banks and slowing erosion. They trap sediment, rebuild, and expand floodplains, raise the water table, and expand riparian communities. Larger and well-vegetated floodplains retain water longer (Tabacchi et al. 2000), raising stream baseflow during the driest part of the year.

Prescribed Fire, Wildfire Management, and Fire Suppression

Prescribed fire, wildfire, and fire suppression would occur under all alternatives. Fire in the upland portions of a watershed may impact the hillslope hydrology of an area by decreasing interception, evapotranspiration, and infiltration. All of these impacts have the potential to increase overland flow and streamflow, leading to stream channel damage from increased flooding intensity and frequency, and a general decrease in basin stability (Neary et al. 2005). The magnitude of fire effects to a watershed is closely related to fire intensity. High-intensity fire can cause profound changes in plant cover and soil function, and can indirectly increase streamflow velocity, sedimentation rates, and water temperatures. Restoration of forest structure and a more natural, low-severity fire regime in frequent fire forests reduces the risk of uncharacteristic, high-severity fire that negatively impacts water quality, flow regime, turbidity, and sedimentation.

Mining

Under all alternatives, leasable mineral activities may have adverse environmental consequences on some watershed resources in the short term and long term. Short-term environmental consequences could include ground disturbance from temporary roads, drilling activities, and construction of authorized well pads, or pipelines. Operation and maintenance impacts may include additional ground disturbance. The effects of these short- and long-term consequences could include changes to surface hydrology. Road and well pad construction limitations related to slope would reduce erosion and mass wasting on steep slopes, which would impair watershed conditions. Avoidance of riparian areas would protect surface waters by reducing the probability for sedimentation along stream channels and spills near drainages.

Conservation Strategies

Implementation of best management practices would continue to be a priority for all management activities. Studies indicate that best management practices result in some level of effectiveness in terms of reduced sediment generation and transport (Edwards et al. 2016).

Environmental Consequences for Watersheds and Water - Alternative 1

Alternative 1 is compliant with the 2012 Planning Rule but is similar to the Carson's current plan (USDA FS Carson NF 1986), which is over 30 years old. Alternative 1 would have the greatest potential to cumulatively impact water resources because it has fewer established objectives and desired conditions for managing the water resources for vegetation, riparian, wetland, and watershed improvement projects. It emphasizes producing timber products; managing quality habitat for Mexican spotted owl and northern goshawk and its prey; providing recreation opportunities to meet demand; and range management. It does not recognize the traditional communities and uses that occur on the Carson or reflect changes in economic, social, and ecological conditions; new policies and priorities; and new information based on monitoring and scientific research. Since this alternative reflects no change in current management, no additional wilderness is recommended. This alternative provides a baseline for estimating the effects of the other alternatives.

Watershed Condition

In 2010, the Carson completed an assessment (using the watershed condition classification approach at the sub-watershed (hydrologic unit code 12) level) indicating that 17 percent of the forest's sub-watersheds are considered to be functioning properly, 82 percent are functioning at risk, and 1 percent are considered impaired. Overall, 83 percent of the Carson National Forest watersheds are not properly functioning. The number of watersheds with indicators functioning at risk or with impaired function indicates there is a widespread need to restore ecosystem resiliency across the landscape. Watershed condition at the sub-watershed scale (hydrologic unit code 12) would likely continue to be primarily in a "functioning at risk" category, due to the change of extent and timing of winter precipitation; risk of stand-replacement fire events in forested watersheds; continued forest management as directed in the 1986 Forest Plan; and increased risk from projected increase of daily average temperatures.

Oil and gas development and production currently occurs within the Jicarilla Natural Gas Management Area. The effects of these short- and long-term consequences under alternative 1 could include increased changes to surface hydrology. Road and well pad construction limitations related to slope would reduce erosion and mass wasting on steep slopes, which would impair long-term soil productivity and watershed conditions. Avoidance of riparian areas would protect surface waters by reducing the probability for sedimentation along stream channels and spills near drainages.

Prescribed Fire, Wildfire Management, and Fire Suppression

Risk of uncharacteristic fire at the landscape scale is greatest for alternative 1, because the prescribed rate of fuel treatments is less than all the other alternatives. High-severity fire can have many impacts to watershed condition, surface water, and water quality. These fires can negatively impact interception, infiltration, evapotranspiration, soil water storage, and overland flow, all of which can affect streamflow discharge.

Riparian Management Zones

Alternative 1 contains some management restrictions in riparian areas, but many activities that have impacts, such as traditional road location, design, construction, and maintenance methods; recreation along streams; vegetation management; and grazing practices, will still occur under current plan direction. All of these activities have the potential for negative impacts such as stream widening from loss of vegetation, erosion, bank destabilization, turbidity, and sedimentation. Past activities have left a legacy of negative impacts on riparian areas across the forest. Under alternative 1, there are no objectives to decommission or naturalize

unnneeded roads, and to some degree these impacts would continue. Riparian areas would continue to be impacted by degraded watershed conditions.

Surface Water and Water Quality

Under alternative 1, uncharacteristically closed-canopy forests would persist, continuing stream flow effects. Evapotranspiration represents the largest loss of water among the components of the hydrologic cycle (Neary et al. 2005). Overstocked forests reduce infiltration and can decrease overall water yield in a given watershed.

Under alternative 1, the current water quality issues of turbidity, high conductance, and sedimentation would continue due to degraded upland vegetation condition, roads and trails in poor condition, and continued grazing.

Environmental Consequences for Watersheds and Water - Alternative 2

Vegetation Management (Mechanized, Prescribed Fire, and Wildland Fire Management)

Alternative 2 would best conserve water resources due to its emphasis on restoration of frequent fire forest types through a combination of mechanical treatments, prescribed fire, and management of natural ignitions; travel management focused on appropriate use of mechanical and motorized vehicles and equipment near water resources; reasonable reduction of the road network through decommissioning, obliteration, or restoration of unneeded and unauthorized routes; adaptive grazing management; and recommendations for wilderness. Alternative 2 has objectives for mechanical treatment and the use of fire for restoring frequent-fire dependent ecosystems. Mechanized vegetation management has the potential to negatively affect water quality, and increase turbidity and sedimentation, due to erosion of soil disturbed using heavy machinery. The use of fire to restore the natural fire regime within watersheds would potentially degrade water quality, reduce water quantity, and increase turbidity and sedimentation due to the loss of vegetation or ground cover. Effects caused by mechanized vegetation management and fire restoration are usually short-term, 3 to 5 years on average, or until vegetative ground cover is reestablished. The long-term effects of these activities would improve watershed condition, stream flow, and water quality.

Riparian Management Zones

Annually restoring 200 to 300 acres of non-functioning and functioning at risk riparian areas (FW-WSW-RMZ-O) would bring watersheds closer to achieving desired conditions, and aligning those areas with priority watersheds would help move functioning-at-risk watersheds to a rating of functioning properly. There would be negative effects from mechanical operations within riparian management zones. These would be short-term and minor, and may include increased sedimentation and turbidity, and degraded water quality, but would be replaced by beneficial long-term effects such as improved hydrologic function. Improvements to the Carson road system would help reduce the sediment load that the current road system contributes to nearby streams. New or reconstructed roads and infrastructure would be located away from water (FW-WSW-G-2). Rerouting roads out of valley bottoms and away from riparian management zones can reduce fragmentation of habitat and road-associated sediment. With less fragmentation of habitat and a more robust expression of riparian vegetation, there would be several beneficial effects such as more shading to help keep temperatures lower instream; better bank stabilization, which can trend toward a lower depth to width ratio (increasing potential for lower temperatures and better aquatic habitat); and better connectivity to the floodplain.

Streams

By reducing fragmentation of stream ecosystems alternative 2 would improve connectivity of habitat for aquatic species and increase areas of refugia for cold water fisheries. Barriers to stream connectivity may exist (FW-WSW-RMZ-STM-DC-3), which could fragment habitat but would protect native species. Objectives listed include replacing two road or stream crossings every five years where chronic

sedimentation is evident. This would be achieved by replacing problem culverts with culverts designed to allow aquatic organism passage that have improved best management practices for reducing road-contributed sediment. This includes matching culvert size to average bank full width and 100-year flood capacity, which would reduce the risk of road failure and large amounts of sediment being introduced into the system due to flooding. Culvert replacement and restoration activities within or adjacent to the stream may (at worst) temporarily degrade water quality in terms of increased turbidity and sediment. These activities are accomplished using heavy equipment or by hand, both of which disturb the ground within or adjacent to flowing water. Adherence to national Forest Service or similar best management practices would mitigate these short-term effects and the restoration activities would lead to long-term benefits of reduced sedimentation and improved habitat and habitat connectivity.

Seeps and Springs

Improving or maintaining the function of at least 10 to 20 springs during each 10-year period following plan approval has the potential to cause minor short-term negative impacts to aquatic biota at the spring site in the form of increased turbidity or sediment, less successful reproduction, and interrupted macroinvertebrate lifecycles (FW-WSW-RMZ-SNS-O). These impacts would be minor and short-term based on the size of a typical spring on the Carson and the small amount of ground disturbance likely required. The long-term benefits of these activities will bring this important resource closer to desired conditions (FW-WSW-RMZ-SNS-DC). Functional springs improve water quality, filtration, and provide important habitat for terrestrial and aquatic species, improve reproductive viability, and create wildlife refuges. Included in the standards for springs and seeps, decontamination procedures would be implemented to prevent introduction of nonnative or invasive biota (FW-WSW-RMZ-SNS-S-1), improving habitat quality, diversity, and species composition.

Recreation

There is an objective to rehabilitate five to seven areas where dispersed camping is causing unacceptable erosion, during each 10-year period of the plan (FW-REC-O-6). If these areas are adjacent to streams, there is potential for the rehabilitation efforts to create short-term, minor effects to water quality, in the form of increased sediment and turbidity. These activities would also likely have long-term beneficial effects to the resources in the form of overall reduction in erosion, sediment loading, and turbidity, and improved streambank stability and water quality.

Transportation and Forest Access

Alternative 2 identifies objectives to improve roads (FW-TFA-O-2) and trails (FW-TFA-O-3) and eliminate unneeded and unauthorized roads and trails (FW-TFA-O-1). When roads and trails intersect or are located adjacent to streams, these improvement activities would potentially have short-term minor negative effects to the hydrologic resources in the form of increased sediment loading and turbidity and degraded water quality. These activities would also likely have long-term beneficial effects in the form of overall reduction in erosion, sediment loading, and turbidity, and improved water quality.

Jicarilla Natural Gas Management Area

Oil and gas development and production currently occurs within the Jicarilla Natural Gas Management Area. The effects of these short- and long-term consequences under alternative 2 could include increased changes to surface hydrology. Road and well pad construction limitations related to slope would reduce erosion and mass wasting on steep slopes, which would impair long-term soil productivity and watershed conditions. Avoidance of riparian areas would protect surface waters by reducing the probability for sedimentation along stream channels and spills near drainages.

Environmental Consequences for Watersheds and Water - Alternative 3

Alternative 3 has more acres of mechanical treatments (three times as many acres as alternative 2) yet constrains the use of prescribed fire for restoration. It has the potential to expand the road network by

eliminating objectives to decommission, obliterate, or restore unneeded routes and allowing for the possibility to increase the road system by converting temporary roads used for restoring system roads or trails. In addition, management of natural ignitions for multiple resource objectives is constrained to areas outside suitable timber areas. It would make improvements to recreation by developing existing campsites, increasing the miles of trail construction and maintenance, and increasing the miles of road maintenance. More resources would be directed toward recreation and fewer toward watershed restoration, compared to alternative 2.

Vegetation Management (Mechanized, Prescribed Fire, and Wildland Fire Management)

Alternative 3 has objectives for increasing acres for mechanical treatment for restoration work in frequent-fire dependent ecosystems, as compared to alternative 2. Mechanized vegetation management has the potential for negative effects to water quality and increased turbidity and sedimentation, due to erosion of soil disturbed using heavy machinery. The use of fire to restore the natural fire regime within watersheds will potentially negatively affect water quality, change runoff timing, and increase turbidity and sedimentation. These effects are caused by the loss of vegetation or ground cover. Because the acres of mechanized treatments are increased, the effects from those activities will increase when compared to alternative 2. Effects caused by mechanized vegetation management and fire restoration are usually short-term, 3 to 5 years on average, or until vegetative ground cover is reestablished.

Riparian Management Zones

Effects are the same as discussed for alternative 2.

Streams

Effects are the same as discussed for alternative 2.

Seeps and Springs

Effects are the same as discussed for alternative 2.

Recreation

Improvements to developed campgrounds in the 10 years following plan approval have the potential to increase sediment and turbidity and degrade water quality when the improvements are located adjacent to streams. These effects are minor and short-term, usually associated with the possible disturbance from improvement activities while they occur. Long-term effects are beneficial in terms of reduced erosion and sedimentation, increased streambank stability, and improved water quality.

Maintaining 200 to 400 miles of trails annually would potentially cause short-term, minor increases in sedimentation and turbidity, and degrade water quality where trails intersect or are adjacent to streams. Increased trail maintenance, as compared to alternative 2 would increase the potential for short-term, localized, negative effects, but would decrease erosion, sedimentation, and turbidity in nearby streams over the long term.

Redesigning or constructing new trails to create a trail system for mountain bikes would potentially impact water resources at those places that the trails would intersect or are located adjacent to streams. For example, there may be increased erosion, sedimentation, and turbidity especially at trail/stream crossings. Mitigation measures in the form of best management practices would be implemented, which would lead to decreased trail-associated erosion and sedimentation.

Transportation and Forest Access

Alternative 3 identifies objectives to increase the miles of improved roads and trails and eliminates alternative 2 objectives for the obliteration or naturalization of non-system roads and trails. Impacts to

watershed condition and water resources from transportation and forest access under alternative 3 would be similar to those under alternative 1. When roads and trails intersect or are located adjacent to streams, these improvement activities would potentially have short-term negative effects to the hydrologic resources in the form of increased sediment loading and turbidity, and degraded water quality. These activities would also likely have long-term beneficial effects to the resources in the form of overall reduction in erosion, sediment loading, and turbidity. By decommissioning fewer miles of non-system roads on the Carson, the negative impacts from these poorly created routes without best management practices would continue to degrade watershed conditions.

Obliteration or naturalization of routes not identified in the motor vehicle use map (alternative 2 TFA-O-1 is removed from alternative 3) would occur where opportunities arose, but less often than under alternative 2, and any positive effects to watershed condition and water resources from additional obliteration or naturalization are negated. Continued sedimentation and turbidity caused by these non-system roads would result in a decrease (negative change) in hydrologic function from road use, miles of system roads, miles of non-system routes, and temporary roads developed for mechanical vegetation treatments within the watersheds where they exist.

Constructing new or temporary roads without mitigating action (alternative 2 TFA-G-3 is removed from alternative 3) to offset resource damage, and future consideration for converting these new road features into system roads or motorized trails (TFA-G-3) would also affect watershed condition and water resources. Forest motorized access would be expanded, increasing the burden of road maintenance on system roads and likely increasing the total land area converted to roads, routes, or trails to an extent that hydrologic function would be impaired by increased erosion and sedimentation into aquatic environments.

Designation of cross-county travel opportunities (MA-OHVMA-DC-1) to provide challenging terrain for motorcycle and off-highway vehicle use would have potential effects to the watershed and water resources within the area designated for this use. Creating or increasing the amount of bare soil exposed and vegetation damage or loss along a limited trail and road system (MA-OHVMA-DC-2) designated for this use would increase erosion and possibly alter hydrologic function within the limited land areas designated for this type of recreational use. However, this management area may also concentrate some of the effects and reduce their overall forest-wide impact by focusing some motorized use in a single area, reducing the amount that occurs illegally on non-motorized trails.

Oil and gas development and production currently occurs within the Jicarilla Natural Gas Management Area. The effects of these short- and long-term consequences under alternative 4 could include increased changes to surface hydrology. Road and well pad construction limitations related to slope would reduce erosion and mass wasting on steep slopes, which would impair long-term soil productivity and watershed conditions. Avoidance of riparian areas would protect surface waters by reducing the probability for sedimentation along stream channels and spills near drainages.

Environmental Consequences for Watersheds and Water - Alternative 4

Alternative 4 emphasizes the use of fire for restoration and decreases the use of mechanical treatment as a restoration tool. This alternative focuses on road decommissioning and obliteration of unneeded roads and temporary roads. This alternative proposes 48,897 acres of recommended wilderness, which would restrict areas suitable for timber production and motorized and mechanical use. This alternative adds the Wetland Jewels Management Area (WJMA), to recognize 10 areas on the forest that are significant wetlands and would have added protections. The Wetland Jewels Management Area includes objectives that prioritize work around those specific wetlands and prohibit new roads, military ground operations, new utility infrastructure, or the establishment of new mineral rights. This alternative focuses on these select few wetlands while ignoring most wetlands across the entire Carson. While this alternative has the potential to improve conditions within these identified wetlands in the long term, the opportunities for improving many wetlands across the Carson would not be realized. Wetland restoration activities do have the potential for short-term negative impacts in the form of erosion, sedimentation, turbidity, and habitat loss.

Alternative 4 does not provide for active management and maintenance of certain grasslands through the elimination of the Grassland Maintenance Management Area.

Vegetation Management (Prescribed Fire and Wildland Fire Management)

The use of fire to restore the natural fire regime within watersheds will potentially degrade water quality, change runoff timing, and increase turbidity and sedimentation due to the loss of vegetation or ground cover. Those effects caused by fire restoration are usually short-term, 3 to 5 years on average, or until vegetative ground cover is reestablished. There is also the potential for long-term beneficial effects in the form of improved watershed condition due to improved upland vegetative conditions.

Riparian Management Zones

While this alternative would emphasize work in 10 areas recognized as significant wetlands, and create added protections for these areas, it ignores other significant wetlands scattered across the entire forest that may have better potential for restoration activities to be successful. Restoration activities in these select wetlands would have the potential for short-term negative effects to wetland function in the form of rutting from the use of heavy machinery during restoration activities. Restoration can also lead to short-term increased erosion and sedimentation. In the long term, restoration activities have the potential for benefits such as improved wetland function, improved aquatic habitat, and reduced erosion and sedimentation.

Streams

Effects are the same as discussed for alternative 2 except that barriers to stream connectivity are discouraged (FW-WSW-RMZ-STM-DC-3), which would reduce habitat fragmentation but would put native species at risk of predation or genetic dilution.

Seeps and Springs

Under this alternative there would be no new spring development. This would result in the remaining undeveloped and undiscovered springs having the entirety of their base flow devoted to spring and ecosystem function. Positive effects would include the potential to provide habitat for diverse riparian and aquatic species. In their undisturbed state, seeps and springs are more resilient to human and natural disturbances and changing climate conditions. There would be no disturbance or negative impacts to the undeveloped springs in this alternative due to development.

Recreation

Effects are the same as discussed for alternative 2.

Transportation and Forest Access

Obliteration or naturalization of at least 40 miles of routes not identified in the motor vehicle use map (TFA-O-1) would result in positive effects to watershed condition and water resources in those watersheds with miles of obliterated or “naturalized” roads. Erosion and associated road sediment would be reduced. These effects would result in an increase (positive change) in hydrologic function and watershed condition from road obliteration or naturalization or both within the watersheds and vegetative communities where this action occurs.

Oil and gas development and production currently occurs within the Jicarilla Natural Gas Management Area. The effects of these short- and long-term consequences under alternative 4 could include increased changes to surface hydrology. Road and well pad construction limitations related to slope would reduce erosion and mass wasting on steep slopes, which would impair long-term soil productivity and watershed conditions. Avoidance of riparian areas would protect surface waters by reducing the probability for sedimentation along stream channels and spills near drainages.

Environmental Consequences for Watersheds and Water - Alternative 5

The effects for alternative 5 are the same as those discussed in alternative 2 with the only difference being the acres of recommended wilderness. Alternative 5 proposes that 67,996 acres or 100 percent of areas evaluated as having wilderness characteristics be recommended for wilderness. When managed as recommended wilderness, several activities described in alternative 2 would not occur in these areas, such as mechanized vegetation treatments, prescribed fire, road construction, or motorized travel. Management of wildland fire would still be considered if conditions are appropriate. The effects of this alternative would be an increased risk of uncharacteristic fire, given the reduction of vegetative management options in these areas. The effects of uncharacteristic wildfire on water resources consist mainly of damage to the vegetation that intercepts precipitation, and the consumption of the underlying litter layer. Severe wildfires can cause profound damage to plant cover and can increase streamflow velocity, sedimentation rates, and stream water temperatures. When fire burns the surrounding watershed, it has the potential to decrease basin stability and in steep, erodible topography, debris flows along with small landslides are common.

Rangeland Sustainability and Grazing Activities

Managing livestock grazing in recommended wilderness would be more difficult due to restrictions on motorized access, making the potential for adverse impacts to surface water resources more likely. Less frequent infrastructure maintenance and more difficult herding would make compliance with management plans and rotation schedules designed to protect resources more difficult. Limited (and occasional) motorized travel by permittees may be authorized in recommended wilderness for allotment management. On the other hand, using motorized and mechanized equipment to maintain range allotments may adversely affect surface water resources by, for example, degrading water quality through increased sedimentation and turbidity.

Cumulative Environmental Consequences for Watersheds and Water

The Carson manages the water resources within its boundaries, but Federal, State, or private boundaries do not often follow watersheds. Generally, the upper portions of watersheds are managed by the Carson and lower-lying areas along valley floors are managed by private landowners interspersed within the forest boundary. Past, present, and future actions that contribute cumulatively to water and water resources include mechanized vegetation management, road management, fire suppression, wildland fire management, prescribed fires, grazing, and recreation. The types of effects associated with these activities were discussed in the effects of alternatives. Site-specific evaluations of cumulative effects to the water resources will be done on a case-by-case basis during future environmental analysis of individual projects.

Actions that improve watershed and hydrologic function will have positive effects on water resources such as improved water quality, decreased sedimentation, improved channel stability, improved wildlife habitat, and flood attenuation. Actions that alter flow regimes, decrease hydrologic function, or reduce flow in streams will have negative effects on water resources such as disrupting fish spawning, degrading stream morphology, degrading water quality, altering riparian vegetation, and lowering water tables.

For the most part, stream systems originate in protected headwaters on the forest and eventually flow downstream onto lands owned or administered by entities other than the Forest Service, flowing ultimately into the Rio Grande.

Federal, pueblo, State, county, and local government land management activities will continue on lands nearby and adjacent to the Carson. These activities are likely to continue affecting water resources, and include but are not limited to road construction and maintenance, timber harvest, fuels reduction, prescribed fire, water diversion, irrigation, livestock grazing, farming, residential and commercial development, chemical treatment of noxious weeds, flood control and stream channel manipulation, and hydropower management. Mitigation measures taken by these various entities help to reduce long-term negative effects.

Non-Federal land management policies are likely to continue affecting water resources. The cumulative effects in the Upper Rio Grande, Upper San Juan, and Rio Chama basins are difficult to analyze considering

the broad geographic landscape covered, the uncertainties associated with government and private actions, and ongoing changes to the region's economy. Whether those effects will increase or decrease in the future is a matter of speculation; however, based on the growth trends and current uses identified in this section, negative cumulative effects are likely to increase.

Many activities occur on private lands within or adjacent to the Carson. These include, but are not limited to road construction, water diversion, irrigation, agriculture, timber harvest, fuels reduction, chemical treatment of noxious weeds, encroachment, flood control, stream channel manipulation, and livestock grazing. These activities are likely to continue, if not increase, and their impacts on water resources are likely to continue.

Climate change, higher temperatures, and more frequent drought will likely continue to be regional stressors, along with population growth, and an increase in demand for water.

Wildlife, Fish, and Plants

Terrestrial, aquatic, and plant species (hereafter referred to as "wildlife") on the Carson contribute to social well-being and quality of life by promoting recreational and educational opportunities. The opportunity to hunt, fish, or just commune with nature is a very important tradition for many of the families and communities who live around the forest. Wildlife in the plan area contribute to economic sustainability through employment opportunities, support of small businesses, and Federal receipts shared with local governments. In 2013, New Mexico Department of Game and Fish (NMDGF) commissioned a study of fishing, hunting, and other wildlife-associated activities to estimate county-level and state-wide contribution to the state's economy (Southwick Associates 2014). The study found 247,600 New Mexico residents and nonresidents fished (160,000), hunted (86,000), or participated in other wildlife-associated activities (1,600) in New Mexico in 2013. Of these participants, 42 percent (103,710) fished, hunted, or viewed wildlife in the four counties encompassing the Carson. These participants spent approximately \$84,814,599 on these activities.

This analysis evaluates and discloses potential environmental consequences on wildlife resources that may result with adoption of a revised land management plan. The analysis includes terrestrial, plant, and aquatic species that are federally listed, bald and golden eagles, Forest Service Sensitive Species, Species of Conservation Concern, and Migratory Bird Priority Species that may occur or may have habitat within the project area. This analysis also includes habitat connectivity for wildlife. When the term "wildlife" is used in this analysis, it incorporates all terrestrial, plant, and aquatic species. Information on the regulatory framework for terrestrial, plant, and aquatic species can be found in [2012 Planning Rule and Directives](#). This section examines, in detail, the existing 1986 Forest Plan, as amended, and four different alternatives for revising that plan and their effects on wildlife resources.

Description of Affected Environment

Elevations within the six ranger districts extend from 6,000 feet (Jicarilla Ranger District) to over 13,161 feet (at the summit of Wheeler Peak) above mean sea level. The lower elevations of the forest are grassland and sagebrush terrain cut by sandy washes and small canyons. Rock outcrops are prevalent. The Carson's topography consists of two distinct mountain ranges, high plateaus or mesas, canyons, valleys, and normally dry arroyos. The landscape is generally mountainous, with numerous perennial streams mostly draining into the Rio Grande; small lakes, alpine valleys, meadows, aspen groves, and virgin spruce-fir forests highlight the area.

Elevation is the dominant localized influence on climate. The lower elevations receive less than 10 inches of precipitation per year, with temperature extremes above 90 degrees in the summer and well below freezing in the winter. The higher elevations receive more than 24 inches of precipitation each year, with summer temperatures in the 80s and winter temperature at zero or below.

The most predominant vegetation types on the Carson are spruce-fir and ponderosa pine forests, each about 20 percent of the national forest. The remainder is composed primarily of piñon-juniper woodland and sagebrush, totaling around 28 percent. There are also a number of isolated riparian areas at springs, seeps, creeks, and lakes. The Carson contributes over 40 percent of the waters that flow into the Rio Grande from northern New Mexico and southern Colorado. The main vegetation system drivers on the forest are fire disturbances (or lack thereof), regional climate regime, insects, and natural vegetation succession.

This evaluation is focused on federally listed, proposed, and candidate species and designated and proposed critical habitats that the USFWS has identified in its Southwest Region Threatened/Endangered Species List (USDI FWS 2020a), the most recent Forest Service Regional Forester’s Sensitive Species List (USDA FS 2013b), the species of conservation concern list developed by the Carson as part of the Ecological Assessment Report for the plan revision process (USDA FS Carson NF 2015a), migratory birds, golden and bald eagles, and habitat connectivity for wildlife.

Ecological Conditions

Species cannot be managed apart from their habitats and much of the assessment of species on the Carson focused on potential and actual habitat available. Riparian and terrestrial vegetative communities were used to describe and map units of similar vegetation, soil, climate, and ecosystem disturbance across the landscape. These communities are the basis for analyzing the vegetative component of species’ habitat.

Terrestrial Habitat

The forest is largely dominated by ponderosa pine, spruce-fir, mixed conifer which, when combined, cover approximately 58 percent of the analysis area (table 32 and table 33). About 50 percent of the vegetation communities on the Carson are highly departed and trending away from reference conditions. These include the vegetative communities of wetland riparian, forest and shrub riparian, ponderosa pine, mixed conifer-frequent fire, piñon-juniper sagebrush woodland, and sagebrush. While the remaining 50 percent of the forest is lowly to moderately departed. Trend was not calculated for vegetation communities that were too small to adequately assess. Refer to Chapter 2: Vegetation in the Ecological Assessment Report for additional detail on vegetation communities (USDA FS Carson NF 2015a).

Non-Forest Vegetation System

The non-forested vegetation systems include alpine and tundra, montane and subalpine grassland, and sagebrush vegetation communities. To measure risk of departure for this vegetation system, herbaceous understory (acres of open seral states) was used as an indication of how well the alternatives provide for ecological integrity ([Herbaceous Understory Vegetation Section](#)).

Herbaceous (grasses and forbs) understory vegetation in the non-forest vegetation system provides habitat, hiding and thermal cover, nesting sites, and food sources for a myriad of animal species. In addition, understory vegetation provides the organic matter needed for soil development and the fine fuels that maintain and support natural fire regimes.

Table 31. Non-forested vegetation system's primary vegetation communities, departure from reference conditions, and trend

Vegetation Community Name (Code)	Acres on the Carson (%)	Current Vegetation Departure	Future Risk of Departure
Alpine and Tundra (ALP)	9,996 acres (0.6%)	Low	Low to Moderate
Montane and Subalpine Grassland (MSG)	125,351 acres (7.9%)	Moderate	Moderate
Sagebrush (SAGE)	59,144 acres (3.7%)	High	Moderate to High
Total	194,491 acres (13%)	not applicable	not applicable

Alpine and tundra includes krummholz (stunted and wind-deformed trees), snow, and alpine habitats. Alpine and tundra covers approximately 9,996 acres, or 0.6 percent, of the forest (USDA FS Carson NF 2015a). Ninety-nine percent of this habitat occurs in designated wilderness. The risk of not achieving desired conditions is low to moderate (table 31).

Montane and subalpine grassland is a mix of a variety of grass communities that comprises 125,351 acres (7.9 percent) of the Carson at all elevations. Risk of not achieving desired conditions is moderate (table 31). Species composition in Montane and Subalpine Grassland has been altered by a legacy of heavy unmanaged grazing, encroachment by woody species, fire exclusion, seeding with nonnative grasses, and drought ([Montane-Subalpine Grassland Vegetation Analysis](#)).

Sagebrush is one of the least common communities on the Carson NF and comprises 59,144 acres (3.7 percent). Risk of not achieving desired conditions is moderate to high (table 31). The sagebrush community is departed due to encroachment of other woody species ([Sagebrush Shrubland Affected Environment](#)).

Forested Ecosystems

Three forested vegetation systems (high-elevation forests, frequent fire forests, and woodlands) found on the Carson comprise approximately 88 percent of the NFS lands. High-elevation forests include bristlecone pine, spruce-fir forest, and mixed conifer with aspen vegetation communities. Frequent fire forest vegetation system includes mixed conifer with frequent fire and ponderosa pine forest vegetation communities. woodlands vegetation system includes piñon-juniper woodlands and piñon-juniper sagebrush vegetation communities. To measure forested ecosystems' risk of departure, seral state proportions (percent), snag density (snags per acre), and coarse woody debris (tons per acre) were used as an indication of how well the alternatives provide for ecological integrity of forested ecosystems (ecological integrity).

Seral states are vegetation classes with unique characteristics (overstory age, composition, and structure). They are defined by overstory conditions and represent a unique phase in the overall succession of the ecosystem. The distribution of seral states within a vegetation community can be related to other ecological conditions necessary for some species, such as snag density (amount of standing dead trees) or the amount of coarse woody debris (amount of dead tree material on the ground). These components may be critical for the persistence of some species and are tied to seral state condition, since seral state impacts the recruitment, retention, and size classes of these features. Departure from reference conditions can negatively impact the ecological condition of vegetation communities. For example, a spruce-fir forest that consists of 80 percent early successional (young) trees lacks the structure and snags provided by older forest that includes dying trees. This can negatively impact wildlife species dependent upon the range of seral states within healthy spruce-fir forests. Vegetation communities with moderate to high risk of departure from desired seral state distribution are likely to provide poorer ecological condition for wildlife, while vegetation communities with low to moderate risk of departure from desired seral state are likely to provide better ecological conditions for wildlife (Werner and Glennemeier 1999).

Another issue caused by out-of-reference seral state is the potential for stand-replacing fires. In both forested and non-forested ecosystems, fuel loads can build to levels that increase the potential for stand-replacing fires. Besides devastating the vegetative conditions within and ecological response unit, uncharacteristic fires can also potentially wipe out at-risk species that reside in those systems, especially if they are rare or endemic. The cause of seral state departure can usually be traced back to long-term human-made actions such as fire-suppression.

When a large tree falls, it becomes coarse woody debris and provides habitat for small animals and insects. When these logs rot, they store water and provide nutrients for the continued growth of the forest. Dead wood rotting on the forest floor eventually gets incorporated into the soil. This underground wood feeds many insects and bacteria that provide nitrogen to feed the trees and other plants in the forest. The importance of coarse woody debris is not limited to upland habitats, it has significant impact on riparian

areas as well and many aquatic species depend on downed woody material. Coarse woody debris not only provides foraging and escape cover for fish, but it contributes to the creation of optimum aquatic ecological condition by slowing down water and contributing to pool development. If the amount of coarse woody debris load (measured in tons per acre) is at moderate or high risk of departure from desired conditions, there may be significant negative impacts to species (Siitonen 2001). If coarse woody debris is not in adequate supply or below desired conditions, it may result in lack of prey items for carnivorous birds or mammals (Mac Nally et al. 2002). On the other hand, if coarse woody debris is in low to moderate risk of departure (excess) it may create unfavorable soil conditions, especially for plant species, by prohibiting growth or germination or may result in more intense fires that negatively impact soil conditions. This is also a key factor in proper functioning aquatic ecological conditions. Thus, the desired condition coarse woody debris loads should provide optimum ecological conditions for terrestrial and aquatic animal species as well as optimum soil conditions for plant species. Vegetation communities with moderate to high risk of departure from desired coarse woody debris are likely to provide poorer ecological condition for wildlife, while vegetation communities with low to moderate risk of departure from desired coarse woody debris are likely to provide better ecological conditions for wildlife.

When a tree dies but remains standing, it becomes a snag and provides habitat for an array of animals, especially birds. Ecologically, a dead tree is as important to the forest ecosystem as a live one (J.F. Franklin et al. 1987) and, according to Marcot (2002), provides several key ecological functions that influence the ecosystem. Snags provide homes for birds and foraging opportunities for insectivorous animals. If snags are not in adequate supply or below desired conditions, identified as snags per acre, it may result in a lack of nesting locations or foraging areas for insectivorous birds or mammals. Conversely, large-scale fire often results in too many snags per acre and not enough live trees. Vegetation communities with high risk of departure from desired snag density conditions are likely to provide poorer ecological conditions for wildlife, while vegetation communities with low risk of departure from desired snag density conditions are likely to provide better ecological conditions for wildlife. Since the wildlife in this analysis prefer larger trees for nesting and foraging, only snags larger than 18 inches diameter at breast height are considered.

Bristlecone pine is the rarest vegetation community (4,585 acres or 0.3 percent) on the Carson (USDA FS Carson NF 2015a). Bristlecone pine risk of not achieving desired seral state conditions, coarse woody debris, and snag density may be moderate (table 32 and [Bristlecone Pine Affected Environment](#)), but its extent on the Carson is too small to model future trend.

Table 32. High-elevation forest vegetation system communities and departure from reference conditions

Vegetation Community Name	Acres on the Forest (percent)	Current Vegetation Departure	Risk of Seral State Departure	Risk of Coarse Woody Debris Departure	Risk of Snag Density Departure
Bristlecone Pine	4,585 (0.3%)	Moderate	May be moderate	May be moderate	May be moderate
Spruce-Fir Forest	289,929 (18%)	Low	Low to moderate	Low	Low
Mixed Conifer with Aspen	130,959 (8%)	Low	Low to moderate	Low	Low
Total	425,473 (29%)	NA	NA	NA	NA

NA is not applicable.

The spruce-fir forest community is the second most abundant (289,929 acres or 18 percent) on the Carson, and occupies the coldest and wettest forested slopes, ridges, and valleys (USDA FS Carson NF 2015a). Currently, 36 percent of this vegetation community occurs in designated wilderness. The risk of not achieving desired seral state conditions for Spruce-Fir Forest is low to moderate (table 32). The risk of snags and coarse woody debris not meeting desired conditions is low (vegetation section).

Mixed conifer with aspen covers 130,959 acres or 8 percent of the forest (USDA FS Carson NF 2015a). Risk of not achieving desired seral state conditions is low to moderate (table 32). The risk of snags and coarse woody debris not meeting desired conditions is low ([Mixed Conifer with Aspen Affected Environment](#)).

Table 33. Frequent fire vegetation system's primary vegetation communities, departure from reference conditions

Vegetation Community Name and Code	Acres on the Forest (percent)	Current Vegetation Departure	Risk of Seral State Departure	Risk of Coarse Woody Debris Departure	Risk of Snag Density Departure
Mixed Conifer- Frequent Fire	182,847 (11.5%)	High	High	High	Low
Ponderosa Pine	312,900 (19.7%)	High	High	High	Moderate-High
Total	495,747 (33%)	NA	NA	NA	NA

NA is not applicable.

Mixed conifer–frequent fire occupies warmer, dryer mixed conifer sites that support more frequent low to mixed severity fire than other mixed conifer sites and comprises 182,847 acres (11.5 percent) of the Carson. Risk of not achieving desired seral state conditions is high. The risk of coarse woody debris not meeting desired condition is also high (table 33). Large snags are underrepresented currently, but the trend is toward desired conditions and risk is low. Stands of mixed conifer–frequent fire vegetation community, across the forest are dense and homogeneous with shade-tolerant, less fire-resistant (white fir and Douglas-fir) tree dominance (Reynolds et al. 2013) and [Mixed Conifer- Frequent Fire Affected Environment](#).

The ponderosa pine forest community is the most abundant (312,900 acres or 19.7 percent) on the Carson. Ponderosa pine forests are at high risk of not achieving desired seral state condition (table 33). The risk of snags and coarse woody debris not meeting desired condition is also high ([Ponderosa Pine Affected Environment](#)). Stands are dense, homogeneous, and dominated by younger trees than desired.

Table 34. Woodland vegetation system primary vegetation communities, departure from reference conditions, and trend

Vegetation Community	Area on the Forest acres (percent)	Current Vegetation Departure	Risk of Coarse Woody Debris Departure	Risk of Snag Density Departure	Risk of Herbaceous Ground Cover Departure
Piñon-Juniper Woodland	178,196 (11.2%)	Moderate	Low	Moderate-High	Moderate
Piñon-Juniper Sagebrush	217,326 (13.7%)	High	Moderate-High	Moderate-High	Moderate
Total	1,316,742 (88%)	NA	NA	NA	NA

NA is not applicable.

Piñon-juniper woodlands comprises 178,196 acres (11.2 percent) of the Carson. Risk of not achieving desired seral state conditions is moderate. Risk of coarse woody debris not meeting desired condition is presumed low (table 34). The risk of snag density not meeting desired condition is moderate to high due to overabundance and risk of herbaceous cover not meeting desired condition is moderate. While seral-state distribution is close to desired conditions, stand density has fluctuated recently from over-dense to more open and snag density is overabundant as a result of a drought-related bark beetle outbreak from 2002 to 2004 that killed a significant portion of the piñon pine component in some woodlands of central and northern New Mexico (USDA FS 2014c).

Piñon-juniper sagebrush occurs on all ranger districts and comprises 217,326 acres (13.7 percent) of the Carson. Risk of not achieving desired seral state and herbaceous ground cover conditions is moderate. The risk of coarse woody debris and snag density not meeting desired condition is moderate to high due to overabundance (table 34). The combined effects of grazing and increased tree canopy have resulted in decreased grass cover ([Woodlands Affected Environment](#)).

Aquatic and Riparian Ecosystems

Riparian Areas

Riparian areas include wetland riparian and forest and shrub riparian vegetation communities. The Wetland riparian vegetation community includes open water wetlands, slope wetlands, marshes, wet meadows, cienegas, bogs, and fens. The forest and shrub riparian community occurs across the Carson in different forms depending on elevation, adjacent upland species, and site-specific conditions. The overstory may be shrubby, in the case of willow-thinleaf alder sites, or tree-dominated with a variety of species depending on elevation and site conditions, including spruce, narrowleaf cottonwood, and Rio Grande cottonwood. There are two aspects of risk to riparian areas—condition and extent. Both are departed from reference condition.

In most riparian areas on the Carson, departure from desired conditions is low to high risk depending on elevation. This is largely a function of legacy and current issues, including roads (authorized or otherwise); water withdrawal, diversion, and storage; developed recreation; dispersed recreation; historically unmanaged grazing by livestock and unmanaged herbivory by wildlife; and seeding with nonnative species. Riparian areas are also impacted by climate trends such as drought.

Loss of hiding, breeding, and forage cover degrades species ecological condition within riparian areas and is a major impact in some areas.

Aquatic Ecosystems

Aquatic ecosystems include perennial streams, waterbodies, and seeps and springs.

There are 1,044 miles of perennial streams in the plan area (USDA FS Carson NF 2015a). The Carson assessed 131 miles of streams for attainment of water quality. Portions of 56 perennial streams are not in full attainment of water quality. Water temperature, turbidity, sedimentation, and specific conductance account for the majority of water quality impairments ([Water Quality](#)). Turbidity and sedimentation often result from degraded upland vegetative conditions or roads and trails in poor condition.

Water quantity is a function of both climate and watershed condition. The current drought in northern New Mexico began in the spring of 1996, following several years of above average temperature, and was exacerbated by subsequent below-average precipitation and continued heat. Stream gauge data from across the forest reflects this same drop in available water. On average streamflow has declined by 20 percent from pre-1996 levels ([Surface Water](#)).

There are 1,565 waterbodies on the Carson totaling over 1,308 acres. This habitat includes lakes, ponds, playas, and stock ponds.

There are 659 documented seeps or springs on the Carson, 597 of which are developed or degraded (90.6 percent).

Cave-like structures, Cliffs, and Rocky Features

Cave-like structures or mine adits, screens, cliffs, and rock features are widespread microsites within all vegetation communities. These ecological conditions are inherently stable for long periods of time because they are changed primarily by geologic forces. There are no known caves on the Carson. Examples of key ecosystem characteristics include cliffs used for nesting by many bird species; cave-like structures and

crevices used for roosting and hibernating by many bat species; and rock outcrops or boulder and talus accumulations used by some mammals for hibernation, shelter from the weather, or to escape from predators.

Special Habitat Features

Many species are also associated with fine-scale habitat features not necessarily captured by the more coarse vegetation community descriptions (table 31 through table 34 above). Other features important to wildlife include coarse woody debris (e.g., downed logs) that provide shelter, food, and moisture retention and standing snags of sufficient size for roosting, nesting, or foraging. These features would impact species if they are departed from reference conditions (USDA FS Carson NF 2015a). These features are somewhat more transient on the landscape and as snags fall down and eventually decay, standing live trees die and become new snags. If the seral stage proportions of most vegetation communities trend toward smaller-diameter trees, future trees may not be large enough to provide the ecological condition required by species that depend on large-diameter snags.

Environmental Consequences for Wildlife, Fish, and Plants

Methodology and Analysis Process

Habitat Relationships (Coarse-Filter, Fine-Filter)

Under the National Forest Management Act (NFMA, 16 U.S.C. 1604(g)(3)(2)), the Forest Service is directed to “provide for diversity of plant and animal communities based on the suitability and capability of the specific land area in order to meet multiple-use objectives, and within the multiple-use objectives of a land management plan adopted pursuant to this section [of this Act], provide, where appropriate, to the degree practicable, for steps to be taken to preserve the diversity of tree species similar to that existing in the region controlled by the plan.” To meet this objective, the 2012 Planning Rule adopts a complementary ecosystem and species-specific approach known as a coarse-filter/fine-filter approach to maintaining species diversity (36 CFR 219.9).

Analysis of habitats emphasizes ecological conditions important to wildlife because many species are strongly tied to individual vegetative types, size classes, and structural characteristics. The analysis presented assumes that species sustainability is best modeled by using what scientific literature designates as typical habitat for a species. A combination of ecosystem (coarse filter) and species-specific (fine filter) conditions are considered and this approach assumes that if the species, genetics, functions, and processes are protected at the community level, then the bulk of the biotic species, both known and unknown, will also be protected. Part of the coarse/fine filter approach also assumes that focusing on the rare species whose persistence is at risk would also provide for diversity of plant and animal communities necessary to meet the diversity requirement of NFMA. The coarse-filter/fine-filter process is described in detail in the at-risk species section of the Ecological Assessment (USDA FS Carson NF 2015a).

Forest plans are developed to guide the maintenance or restoration of structure, function, composition, and connectivity of ecosystems to provide ecological conditions that will maintain a diversity of plant and animal communities and support the persistence of most native species in the plan area. This analysis focuses on evaluating the consequences of the plan alternatives on at-risk species. Forest Service at-risk species include two categories: (1) federally designated species and habitat (species listed as threatened or endangered, species that are proposed or candidates for Federal listing, and species with designated critical habitat on the national forests), and (2) Forest Service-designated species of conservation concern.

The basis for the analysis requires a determination of whether plan components such as desired conditions, objectives, standards, and guidelines provide direction to provide the ecological conditions necessary to contribute to the recovery of federally recognized species and maintain the persistence of species of conservation concern within the plan area. Plan components were developed in an iterative way, which included identifying desired conditions and potential threats to species, and identifying whether proposed

plan components are sufficient to address species and their habitat needs (Forest Service Handbook 1909.12 12.52.c-d). It is also recognized that due to circumstances that are neither within the authority of the Forest Service nor consistent within the inherent capability of the land, the plan area may be unable to provide the ecological conditions necessary to maintain a viable population of a particular species of conservation concern. When this occurs, the final environmental impact statement documents this and, where possible, focuses on other efforts to contribute to maintaining a viable population of the species within its range (36 CFR 219.9(b)(2)) that are within the capability and authority of the Forest Service.

Indicators and Measures

Federally Listed Species

This analysis evaluates two primary aspects for federally listed species. First, the adequacy of plan direction in each alternative to protect, maintain, and restore habitat elements identified for species and primary constituent elements of designated critical habitat and to provide for recovery of listed species. Second, the adequacy of plan direction to avoid, minimize, or mitigate potential short-term adverse effects to federally listed species and candidate species, focusing on relevant threats on the Carson to individuals within occupied and critical habitat. The analysis also considers the authority of the Forest Service and the inherent capability of the plan area to provide for federally listed species. An analysis for the selected alternative will be documented in detail in a biological assessment to be submitted to the U.S. Fish and Wildlife Service and available in the project record.

Species of Conservation Concern

The 2012 Planning Rule defines a species of conservation concern as: a species, other than a federally listed threatened, endangered, proposed, or candidate species, that is known to occur in the plan area and for which the regional forester has determined that the best available scientific information indicates substantial concern about the species' capability to persist over the long term in the plan area (36 CFR § 219.9; 77 FR 21169). The Carson followed the guidance provided in the proposed directives for the 2012 Planning Rule (Forest Service Handbook [FSH] 1909.12 – Land Management Planning, Chapter 10) in developing this list. More information about the Carson National Forest species of conservation concern selection process can be found on the Carson's [Species of Conservation Concern webpage](#).

The species of conservation concern list guides planning; however, the designation of these species is not a plan decision. Just as there is a process for U.S. Fish and Wildlife Service to change the Federal listing status of a species, the regional forester has authority to change species of conservation concern lists to reflect new information.

Ecological Conditions and Quantity

Key indicators for the terrestrial and aquatic species analyses are trends toward reference ecological conditions and habitat quantity. Primary habitat associations and threats are described for each at-risk species. Habitat quantity is evaluated by the potential trend in relative amount and distribution of ecological conditions in the plan area over the next 15 years. Ecological condition is evaluated by the predicted trend in resiliency and ability of habitats to adapt to large-scale disturbances (such as wildfire, insect outbreaks, and drought).

Alternatives affect overall ecological conditions and move ecological conditions toward the desired state at different rates. These indicators were selected because they provide a reasonable assessment of ecological conditions needed to support the persistence of species of conservation concern and because relative differences among alternatives could be readily compared. Qualitative comparisons were used where quantitative data on habitat were unavailable. The amount of habitat provides a relative measure of ecological condition and extent to maintain species persistence and is also an appropriate measure for a programmatic level analysis. Ecological condition is used as an indicator only when it can be adequately

determined at the programmatic-level, such as assessing not only the amount of impact from wildfire but also the type of fire and the resulting effects on ecological conditions.

For plan revision, management direction that may alleviate or exacerbate threats to ecological condition are evaluated at a programmatic level. The plan does not authorize site-specific projects or activities; therefore, there are no direct effects from adopting the plan. Direct and indirect site-specific effects will be analyzed when future projects are proposed. Although potential short-term consequences may be described where appropriate from implementing the programmatic approach, this evaluation focuses on longer term indirect and cumulative effects that may occur over the 15-year-life of the plan.

Much of the analysis is based upon the premise that the natural range of variation provides important background information for evaluating ecological integrity and sustainability (Weins et al. 2012). The natural range of variation was used in development of plan direction (desired conditions) and selection of indicators and measures for the analysis. This approach was used because the condition and quantity of habitat available to a species helps predict the potential for species distribution and abundance within that ecological condition. Furthermore, consideration of climate and associated fire trends that may create a suite of conditions that are outside of the natural range of variation are important in the analysis of ecological integrity and sustainability of vegetation communities (Millar and Stephenson 2015).

Coarse-filter plan components (largely centered on desired conditions within the natural range of variation) are expected to provide for ecological conditions necessary to maintain the persistence or contribute to the recovery of native species within the plan area. The coarse-filter approach is considered the primary context for evaluating at-risk species. Where coarse-filter components would not provide sufficient conditions for one or more at-risk species, fine-filter (species-specific) plan components, including standards and guidelines, were incorporated. This analysis includes:

- Departure and trend of key ecosystem characteristics (vegetation communities or other ecological condition elements defined in the preceding section) needed by each species and how well plan components address that trend, either toward or away from desired state.
- How well species' primary threats are addressed and key ecological needs are provided for at the ecosystem level (course filter plan components).
- How well species' primary threats are addressed and key ecological needs are provided, which are not already addressed by the above components (i.e., fine-filter, additional plan components that were added to address threats and minimize risk).

Spatial and temporal analysis

In general, the analysis area for environmental consequences includes all lands managed by the Carson National Forest (figure 1); however, it may include areas outside the national forest boundary, such as critical habitat adjacent to the planning unit which could be affected by forest management. In some cases, the Carson provides all or a high percentage of the ecological condition for a given species; however, in most instances, wildlife generally move from area to area and ecological conditions across multiple land jurisdictions may be important to the overall persistence of the species within its range. Cumulative effects analyses generally include lands within other ownerships immediately adjacent to the national forest including Rio Grande del Norte National Monument, Taos Pueblo, Picuris Pueblo, Jicarilla Apache, adjacent Federal land, and comparatively smaller sections of State, county, and privately owned lands. For some wide-ranging species, the analysis area is a little larger and includes an evaluation of connectivity between larger areas of habitat. For species with migratory or travel routes that extend far beyond the Carson, management direction under alternatives 2, 3, 4, and 5 would only influence ecological condition (both quantity and condition) within the plan area, as actions that occur outside the Carson boundary are not within Forest Service management authority.

The anticipated life of the plan is 10 to 15 years. However, because management actions have potential to affect wildlife species and their ecological conditions for many decades, the temporal analysis for modeled vegetation change and cumulative effects discusses changes that may occur over the next 50 years as conditions change and vegetation moves from one successional stage to another.

Assumptions

- If a species is associated with a particular habitat, then the ecological conditions, amount, and distribution of those habitat elements available to the species on the landscape help to predict its distribution and abundance.
- Abundance and distribution of ecological conditions across the landscape similar to that which supported associated species during past changes in conditions, will likely contribute to their maintenance in the future (Haufler 1999). Animals have evolved in their habitats, usually under reference vegetative conditions, including specific habitat features. Therefore, habitat abundance, distribution, and condition similar to that within the reference conditions for the habitats will likely contribute to species maintenance in the future.
- In general, the further ecological condition is departed from desired conditions (natural range of variation), the greater the risk to persistence of associated species. Conversely, the closer ecological condition is to desired conditions, the lower the risk to persistence of associated species. Therefore, comparing the degree to which the alternatives trend conditions toward desired conditions provides a comparison of each alternative's effectiveness at providing ecological conditions that contribute to maintaining species persistence.
- Terms and conditions and reasonable and prudent measures resulting from USFWS consultation on the programmatic framework of the plan will be followed when planning or implementing new site-specific projects and activities, unless modified by site-specific consultation.

Alternatives are evaluated in terms of how well they achieve the same set of desired conditions, regardless of whether the alternative articulates those desired conditions.

Federally Listed Species

Federally listed threatened and endangered species are those plant and animal species formally listed by the U.S. Fish and Wildlife Service (USFWS) under authority of the Endangered Species Act of 1973, as amended. Pursuant to section 7(2)(a) of the Endangered Species Act, a biological assessment was prepared to assess the effects of implementing the Carson plan preferred alternative on endangered and threatened species and ensure that proposed actions in the selected alternative would not jeopardize the continued existence of listed species. Table 35 identifies the five federally endangered and four threatened species listed for the four counties (Rio Arriba, Taos, Colfax, and Mora) of the Carson (USDI FWS 2020a). There are no proposed or candidate species listed for the counties. Only species that use the national forest, have suitable habitat present, and or could be impacted by off-forest management effects (e.g., downstream effects) were fully analyzed.

Table 35. Federally listed species for the counties of the Carson NF (USDI FWS 2020a)

Species Common Name	Species Scientific Name	Federal Status	Critical Habitat within analysis area	Recovery Plan
Jemez Mountain salamander	<i>Plethodon neomexicanus</i>	Endangered	No	No
Least tern	<i>Stern antillarum</i>	Endangered	No	Yes
Mexican spotted owl	<i>Strix occidentalis lucida</i>	Threatened	Yes	Yes
Piping plover	<i>Charadrius melodus</i>	Threatened	No	Yes
Southwestern willow flycatcher	<i>Empidonax traillii extimus</i>	Endangered	Yes	Yes
Western yellow-billed cuckoo	<i>Coccyzus americanus occidentalis</i>	Threatened	None designated	No
Black-footed ferret	<i>Mustela nigripes</i>	Endangered	None designated	Yes
Canada lynx	<i>Lynx canadensis</i>	Threatened	None designated	No
New Mexican meadow jumping mouse	<i>Zapus hudsonius luteus</i>	Endangered	None designated	No

Species Status, Key Ecological Conditions and Threats

Jemez Mountain salamander, least tern, and piping plover

The USFWS lists the Jemez Mountain salamander, least tern, and piping plover for Rio Arriba or Colfax Counties, but their range within these counties does not include the Carson NF (USDI FWS 2012a) and would not be impacted by off-forest management effects.

Mexican spotted owl

Mexican spotted owl has designated critical habitat (23,182 acres) on the Jicarilla Ranger District. Numerous surveys throughout the forest have not confirmed breeding of this species on the Carson since the critical habitat was designated. This species is non-migratory and feeds primarily on small mammals. The Mexican spotted owl requires a variety of mixed conifer habitats, proximity to riparian areas, standing snags for roosting and nesting, and typically rocky outcrops. Timber harvest, prescribed burning, and other management activities are designed around Mexican spotted owl critical habitat. Threats include departure in seral state conditions amount of coarse woody debris, and snag density from loss of dense, old-growth mixed conifer forest, changes in fire regime, and from stand-replacing fire.

Critical habitat acreages of the Carson contain constituent elements including mixed conifer forest types, rocky cliffs, canyons and cliffs, and riparian areas that are required for survival by the Mexican spotted owl. The 1996 amendment to the Carson Forest Plan provides guidance for the management of Mexican spotted owl habitat and is consistent with the 1995 Mexican Spotted Owl Recovery Plan. Standards from the 1996 plan amendment specify three levels of habitat management for Mexican spotted owl: protected habitat, restricted habitat, and other forest and woodland types. Protected areas include protected activity centers, mixed conifer stands with slope greater than 40 percent where timber harvest has not occurred in the past 20 years, and all legally and administratively reserved lands. Restricted areas consist of unoccupied Mexican spotted owl habitat that is managed for nesting and roosting conditions. A minimum of 25 percent of Mexican spotted owl restricted habitat is to be managed to provide nest/roost characteristics of 150 to 170 square feet per acre basal area and at least 20 trees per acre that are 18 inches diameter at breast height (DBH) or larger.

The Mexican Spotted Owl Recovery Plan was revised in 2012 and terminology for Mexican spotted owl habitat was updated. Protected habitat, restricted habitat, and threshold habitat are now referred to as nesting/roosting habitat, forested recovery habitat, and recovery nesting/roosting habitat (USDI FWS 2012b). Terminology, planning, and implementation related to this analysis will follow the terminology and standards

and guidelines included within the 1996 plan amendment until the decision for the new plan for the Carson National Forest has been completed and signed.

There are approximately 313,806 acres of mixed conifer on the Carson. Using data from the vegetation analyses, the amount of Mexican spotted owl recovery area is estimated at approximately 196,971 acres. The Mexican spotted owl critical habitat is estimated at 23,182 acres.

Using data from the vegetation analyses it is possible to calculate the amount of habitat on the forest in the primary vegetation systems used by the owl that likely contains potential nesting or roosting habitat (characterized by larger trees and closed canopy). There are an estimated 41,439 acres within the mixed conifer vegetation that contain this type of habitat.

Southwestern willow flycatcher and western yellow-billed cuckoo

Southwestern willow flycatcher has designated critical habitat (123 acres) on the Camino Real Ranger District where it is federally listed as endangered. This species relies on dense riparian areas, usually dominated by willow species (forest and shrub riparian vegetation communities). Threats include degradation of riparian habitat through the loss of willow and cottonwood density and recruitment, reduction of in-stream flow, invasive species encroachment, and nest parasitism by the brown-headed cowbird.

Western yellow-billed cuckoo is federally listed as threatened west of the Rio Grande (distinct population segment), and no critical habitat has been designated on the Carson for this species. Western yellow-billed cuckoo inhabits dense riparian habitat greater than 200 acres (81 hectares) in size (Poole 2018) and below 7,000 elevational feet (Howe and Hanberg 2000) in the western U.S. Western yellow-billed cuckoo has not been documented on the Carson and the dense riparian habitat it inhabits is extremely rare on the Carson NF. Ecosystems that could support the western yellow-billed cuckoo are forest and shrub riparian below 7,000 elevational feet and include narrowleaf cottonwood-shrub and Rio Grande cottonwood-shrub habitat. It is possible that the species uses the national forest as migratory habitat. The major threat faced is degradation of riparian habitat through the loss of cottonwoods density and recruitment, reduction in in-stream flow, and invasive species encroachment. Habitat loss and degradation are caused by a variety of factors, including urban, recreational, and agricultural development; water diversion and groundwater pumping, channelization, dams; and excessive livestock grazing. They are also susceptible to collision with towers and turbines.

Black-footed ferret

Black-footed ferret is federally listed as endangered and no critical habitat has been designated on the Carson. This species relies on montane subalpine grassland vegetation communities and is highly dependent on the presence of prairie dog colonies of at least 80 to 100 acres in size, depending upon the prairie dog species (USDI FWS 2013). Currently, there are no prairie dog colonies of this magnitude on the Carson, and black-footed ferret are not currently known to occur on the Carson NF. Black-footed ferrets spend about 90 percent of their time underground, where they eat, sleep, and raise their young in prairie dog burrows. Prairie dogs make up the majority of the black-footed ferret's diet. Threats include loss of habitat (burrows) and food, as prey base (prairie dogs) are affected by sylvatic plague.

Canada lynx

On March 24, 2000, the USFWS published the final rule listing the contiguous United States distinct population segment of Canada lynx as a threatened species (65 FR 16052); however, Canada lynx is currently under review for delisting due to recovery as of January 2018. The USFWS prepared a recovery outline for the Canada lynx (USDI FWS 2005), as a recovery plan has yet to be developed. A recovery outline is intended to provide interim guidance for consultation and recovery efforts until a formal recovery plan has been approved. Under the recovery outline, lynx habitat was ranked into core, secondary, and peripheral areas based on lynx occupancy, reproduction, and use as documented by historical and current records. Lynx habitat was not ranked for core, secondary, or even peripheral for the Carson (USDI FWS 2005), and critical habitat has not been designated on the Carson (USDI FWS 2020a). Historically, the

Carson did not support a naturally resident lynx population (USDI FWS 2014b) and is currently not known to den or breed on the forest. Occasionally an individual lynx may roam out of Colorado onto the Carson. In New Mexico, this species is a habitat specialist confined largely to mid- to high-elevation boreal and subalpine spruce-fir forests at 9,800 to 12,000 feet elevation (Koehler and Brittell 1990; Ruggiero et al. 1999) that can maintain the presence of deep snow.

Snowshoe hare is the primary forage for this species. Lynx do not occur everywhere within the range of snowshoe hares in the contiguous United States, as discussed in both Bittner and Rongstad (1982) and McCord and Cardoza (1982). This may be due to inadequate abundance, density, the spatial distribution of hares in some places, the absence of snow conditions that would allow lynx to express a competitive advantage over other hare predators, or a combination of these factors (USDI FWS 2014b). In the southern part of its range, including New Mexico, the low densities of lynx populations are likely a result of naturally patchy habitat and lower densities of their snowshoe hare prey (Griffin 2004; Mills et al. 2005).

Lynx do not typically reside on the Carson because the forest lacks the aforementioned physical and biological features necessary to sustain a population (USDI FWS 2014a). Management threats include departure of seral state condition through loss of dense, spruce-fir forest, loss of coarse woody debris per acre, and loss of snow depth and retention. Another management threat includes an increase in human intrusive disturbance from motorized road construction, over-snow motorized travel, and dispersed recreation.

In 2008, the Southern Rockies Lynx Management Direction amended seven plans of the national forests in Colorado and southern Wyoming (USDA FS Rocky Mountain Region 2008) but did not include any national forest in New Mexico. The amendment adopted plan components applicable to vegetation management, livestock grazing, human uses, and linkage areas in order to conserve and promote the recovery of the lynx by reducing or eliminating adverse effects from land management activities on NFS lands while preserving the overall multiple-use direction in existing plans (USDA FS Rocky Mountain Region 2008). In October 2000, the USFWS issued a biological opinion on the effects of the Southern Rocky Mountains lynx amendment on the distinct population segment of Canada lynx in the contiguous United States. In its 2000 biological opinion, USFWS concluded that the level of adverse effects to lynx that may result from implementing the Southern Rockies Lynx Management Direction are not reasonably expected to either directly or indirectly appreciably reduce the likelihood of survival and recovery of the lynx distinct population segment in the wild by reducing the reproduction, numbers, or distribution of lynx (USDA FS Rocky Mountain Region 2008). Several comments and requests from the public were made concerning how lynx is covered in the Carson's plan and that the Southern Rockies Lynx Management Direction be included in that document. Appendix H displays the Southern Rockies Lynx Management Direction and the corresponding revised plan components to that direction.

New Mexico meadow jumping mouse

New Mexico meadow jumping mouse is federally listed as endangered, and no critical habitat has been designated on the Carson. This species occurs in the western U.S. in dense, mid-elevation, riparian areas (wetland and forest and shrub riparian) with dense and tall grass key ecosystem characteristics. It was historically documented on the Carson, but recent surveys on the national forest were unable to detect this species (Frey 2006, 2012). The Carson currently has potential habitat for this species, but it is limited and highly fragmented. Major threats include departure of herbaceous understory vegetation by loss of vegetation diversity and height, reduction of in-stream flow, invasive species encroachment, and post-wildfire flooding events. Habitat loss and degradation are caused by a variety of factors, including grazing pressure, water management and use, lack of water due to drought or climate change, wildfires, and certain recreation activities.

Environmental Consequences for Federally Listed Species

Environmental Consequences for Federally Listed Species Common to All Alternatives

Effects of probable management activities that could potentially affect wildlife communities can be grouped into three broad categories: (1) changes in the type, quantity, quality, and spatial arrangement of suitable ecological conditions; (2) direct mortality, reduced survival, or increased susceptibility to mortality; and (3) increased disturbance.

For each species or group of species, the plan considers the extent that ecosystem-level plan components provide for ecosystem integrity and diversity to meet the ecological conditions necessary for those species within their range. Species-specific plan components were added as needed. Appendix H lists the forestwide plan components that would apply to at-risk wildlife, plant, and aquatic species (including federally listed species) under all action alternatives. The action alternatives have additional place-based management area plan components or objectives which are described in their individual sections. The following analysis applies to plan components shared in common.

All five alternatives would use mechanical vegetation treatment and wildfire to manage frequent fire forest (e.g., ponderosa pine and dry mixed conifer) and mechanical vegetation treatment or structural improvement to manage riparian/water resources (e.g., aquatics, forested riparian) to improve ecological condition, abundance, and distribution for species that depend on those vegetation communities. These systems are all highly departed from reference conditions. Current science demonstrates the positive benefits that forest fuel-reduction treatments can have in terms of improving resiliency in frequent fire-adapted systems of the West and Southwest (Stephens et al. 2012). Conditions and trends in the other vegetation communities did not raise significant concerns, therefore, no objectives were developed for them. The Carson has, however, identified desired conditions for these other vegetation communities and would implement management to make progress toward desired conditions as capacity allows.

The primary needs for threatened and endangered species are addressed through law, regulation, and policy (such as recovery plans and conservation agreements), which are incorporated by reference. The plan provides the framework for implementing the recommendations from these higher-level laws, regulations, policies, plans, and agreements for these species, with limited needed additional direction (appendix H).

For federally listed species that use frequent fire forests (dry mixed conifer and ponderosa pine), riparian (wetlands and forested riparian), and aquatic systems, like the Mexican spotted owl, southwestern willow flycatcher, western yellow-billed cuckoo, and New Mexico meadow jumping mouse, the primary contemporary threat is loss of habitat related to large stand-replacing fire and livestock grazing, associated run off and sedimentation that could affect riparian habitat, and reduced in-stream flow. All alternatives would move habitat for these species toward the desired state but vary in magnitude, intensity, and location of treatments. There could be some localized adverse impacts to these species from management actions such as livestock grazing and recreation, but overall species viability would be maintained. Objectives to treat acres in frequent fire forests, riparian, and aquatic systems (departed systems) would move them toward a vegetative or aquatic state more complementary to species that use these systems' evolution by increasing the amount of habitat in the desired seral states or properly functioning condition for breeding, roosting, and foraging.

A recent synthesis by Gutierrez et al. (2017) highlights the benefits of mixed severity fire in northern spotted owl habitat in California and noted that strategically placed landscape treatments can reduce fire severity and spread and that by combining fuel treatments with prescribed and managed fire the extent of high-intensity fires in the Sierra Nevada could be effectively reduced under most conditions. On the Kaibab National Forest in Arizona, Reynolds et al. (2017) assessed the effects of mixed fire severity on goshawk productivity in the Warm Fire footprint, a 91-square-mile fire that burned in ponderosa pine and mixed-conifer forests. The focus of their study was to assess how low- and high-severity fire affected nest survival and productivity. They assessed post-fire activity at 20 territories in areas of high- and low-severity fire and found that

territories that lost more than 75 percent of the forest to moderate- and high-severity fire were not reoccupied, while territories that lost between 50 to 75 percent of the forest to moderate- and high-severity had only 43 percent reoccupation following the fire. Post-fire occupancy of a nest area in a burned territory depended on the availability of at least one alternate nest stand in the territory that had escaped high-severity fire. Their study demonstrates management strategies for mixed fire. Ray et al. (2014) found that forest treatments such as thinning and prescribed fire in ponderosa pine forest had relatively minor effects on goshawk occupancy compared to stand-replacing fire that had occurred in the same area. Their study demonstrated active forest restoration is necessary to avoid the more pronounced and widespread degradation or loss of habitat.

The USFWS lists the Jemez Mountain salamander, least tern, and piping plover for Rio Arriba or Colfax Counties, but their range within these counties does not include the Carson (Degenhardt et al. 1996; Poole 2018; USDI FWS 2012a) and would not be impacted by off-forest management effects. As such, there is no effect to these species or their critical habitat from any of the alternatives.

Black-footed ferrets, critical habitat, and habitat for black-footed ferret, currently do not occur on the Carson. There are no prairie dog colonies of at least 80 to 100 acres in size on the Carson—the key habitat requirement for this species. As such, there is no effect to this species or its critical habitat from any of the alternatives. However, if black-footed ferret are found on the national forest in the future, the primary needs for this species are addressed through law, regulation, and policy (such as recovery plans and conservation agreements), which are incorporated by reference within all alternatives.

Conservation Measures

Risk to species viability is reduced by provisions in existing law and policy. For all alternatives, the forest would continue to follow the intent of all recovery plans for federally listed species even if actions within those plans do not match the forest's desired conditions for the particular resource area. These include specific consideration of effects to federally listed species (proposed, threatened, and endangered species) in biological assessments conducted as part of all national forest management decisions. These assessments identify where additional protective measures are warranted to provide for continued existence of the species on NFS land. Projects that may affect federally listed or proposed species must be coordinated with the U.S. Fish and Wildlife Service during the project planning stage to mitigate potential impacts to listed species under Section 7(a) (2) of the Endangered Species Act. In addition, section 7(a) (1) of the Endangered Species Act directs Federal agencies to use their authorities to carry out programs for conserving threatened and endangered species. The forest currently fulfills this duty as described below.

Mexican spotted owl

- Work with USFWS to establish protected activity centers for Mexican spotted owls using criteria set forth in the most current recovery plan.
- Conduct fuels reduction projects which may benefit the Mexican spotted owl in the future. These projects focus on reducing the potential for large, stand-replacing wildfires that are a threat to the species while still maintaining or enhancing structural habitat features (e.g., large trees, snags, and downed woody materials).
- Monitor protected activity centers and provide USFWS with monitoring and project survey results annually.
- Support new, broad-scale, population monitoring efforts as defined by the Revised Mexican Spotted Owl Recovery Plan (USDI FWS 2012b).
- The Regional Office has funded implementation of a long-term population occupancy study on NFS lands in the Southwestern Region, which includes the Carson. In conjunction with the Bird Conservancy of the Rockies (BCR), the Forest Service Southwestern Region has currently monitored Mexican spotted owls for six breeding seasons (2014–2019) and will continue to monitor in the future.

Southwestern willow flycatcher

- Implement Carson-specific actions of the Southwestern Willow Flycatcher Recovery Plan.
- Implement a monitoring plan to better determine the trend of southwestern willow flycatchers on the forest.

Eligible Wild and Scenic Rivers

A comprehensive evaluation of wild and scenic rivers was conducted as part of the plan revision process, resulting in 51 eligible wild and scenic river segments on the Carson. This would have potentially beneficial impacts by limiting the types of instream infrastructure. Limiting the types of instream infrastructure would provide habitat connectivity and minimizing ground disturbance on southwestern willow flycatcher, western yellow-billed cuckoo, and New Mexico meadow jumping mouse that use riparian habitat.

Designated Wilderness and Inventoried Roadless Areas

Designated wilderness (129,119 acres) and inventoried roadless (105,000 acres) areas provide beneficial impact for habitat connectivity and minimize disturbance to federally listed species through primitive management or lack of road construction.

Developed Winter and Summer Resort Management Area

The Developed Winter and Summer Resort Management Area comprises permitted ski areas on the Carson. Under alternative 1, this management area is currently in an altered vegetative state from reference condition and would continue to be managed as such under all alternatives. This management area could possibly decrease habitat connectivity within its boundaries for Mexican spotted owl and Canada lynx. This management area would also increase ground disturbance from ski area development and increase human-intrusive disturbance to these species under all alternatives. The substantive difference among alternatives for the Developed Winter and Summer Resort Management Area is under alternative 3 where the management area would be expanded by 921 acres around the Sipapu Ski and Summer Resort. The current Sipapu permitted boundary is 215 acres and would not change under any alternatives except alternative 3 where it would likely be expanded through a separate analysis. The effect of this change is discussed in Environmental Consequences – Alternative 3.

Jicarilla Natural Gas Management Area

All five alternatives include the Jicarilla Natural Gas Management Area. Under these alternatives, decisions regarding leasable mineral activities in the Jicarilla Natural Gas Management Area would align with law, regulation, and policy, and would be consistent with plan decisions for other resource areas to the extent possible.

Leasable mineral activities within the Jicarilla Natural Gas Management Area may have both short- and long-term adverse environmental consequences on federally listed species. Short-term effects could include increased human activity, such as motorized traffic, noise from drilling equipment, temporary roads, ground disturbance during drilling activities, and construction of authorized well pads, or pipelines. Long-term effects could include impacts from operation and maintenance of the authorized facilities over the life of the facility. Operation and maintenance impacts may result in increased human activity and noise, motorized vehicle traffic, or additional ground disturbance. The effects of these short- and long-term consequences could include wildlife displacement and habitat fragmentation.

Standards and guidelines requiring mitigation measures lessen these effects by protecting resources affected by mineral operations, including specific standards to ensure reclamation to stable, productive conditions consistent with forestwide desired conditions. Timing limitations on new drilling activity and completions would limit disturbance and minimize risks to reproduction during critical breeding and fledging period. This ensures the health and persistence of these species on the landscape. Co-location of pipeline, road, and other

infrastructure, road design limitations, and well siting measures that limit surface disturbance would decrease soil loss and compaction, vegetation removal, and habitat fragmentation. Avoidance of riparian areas would protect wildlife habitat and surface waters by reducing the probability for sedimentation along stream channels and spills near drainages.

Climate Change

Climate change has occurred to some degree and will continue. Ramifications of a changing climate on federally listed species are likely to include reduced snowfall or earlier snowmelt in the spring, extended periods of drought or extended dry periods in the spring and summer, more frequent and larger wildfires, increased insect- and disease-induced mortality, and changes in site characteristics that promote type conversion or vegetation community changes. This pattern is consistent with current trends in other parts of the West (Bentz et al. 2010).

These changes cause seasonal ranges and food sources for wildlife to shift and can affect the timing of reproduction. Reduced snowpack and changes in precipitation can affect lynx by loss of prey base through increased competition with bobcats and coyotes. Forested tracts and remote habitats for all wildlife can also become isolated, reducing landscape connectivity and ecological condition for species with limited dispersal ability. The timing of spring green-up can also affect food availability for migratory birds or forage conditions for big game. Those species with highly specialized ecological condition requirements, at the edge of their range, currently in decline, and/or having poor dispersal abilities may be particularly at risk (National Fish Wildlife and Plants Climate Adaptation Partnership 2012).

Climate change presents an aspect of uncertainty in future conditions, disturbance regimes, and vegetative and wildlife responses. Strategies that can be used to help reduce impacts from climate change include managing for diverse conditions; maintaining healthy and connected populations; reducing the risk of large, uncharacteristic fire; preventing and controlling invasive species; and ensuring ecosystem processes and habitat connectivity (The Heinz Center 2008). While how well each of the alternatives addresses these strategies varies, it is assumed that to a certain extent, climate change and associated effects to federally listed species would occur under all alternatives. The Climate Vulnerability Assessment for the Carson (USDA FS 2014a) provides additional information on the vulnerability of the different vegetation communities and habitat types to climate change.

Summary

Under all alternatives, for all vegetation types except frequent fire forests, future management would be similar to current management, and consequently, environmental consequences are expected to be similar under all plan alternatives. All vegetation types are expected to remain either low to moderately departed (at risk) in the near and distant future ([Vegetation Environmental Consequences](#)). These same conditions and trends also apply to vegetation-related characteristics such as fire regime, patch size, species composition, ground cover, soil condition, etc., as these characteristics are intricately associated with, and dependent on, vegetation structure.

The amount of high elevation forest, non-forested, and woodlands vegetation systems, and abiotic features, including caves/mines, rocky outcrops, cliffs, canyon habitat, and soils, are not expected to change under any alternative. For black-footed ferret and Canada lynx that depend on these vegetation and ecological conditions, viability would be maintained through plan components that minimize risk for disturbance. Active management activities could affect individual animals but would not lead toward Federal listing or loss of viability.

For all alternatives, future management is concentrated in the frequent fire forest, riparian, and aquatic systems which are the most highly departed from reference conditions. Management intensity in these systems varies by alternative but, overall, all alternatives move the Carson toward the desired state (table 5).

Environmental Consequences for Federally Listed Species – Alternative 1

The current 1986 Forest Plan, as amended, would have impacts to Mexican spotted owl, southwestern willow flycatcher, western yellow-billed cuckoo, black-footed ferret, Canada lynx, New Mexico meadow jumping mouse, and their critical habitat. The key ecological conditions for federally listed species and the key threats affecting those conditions are described below for all action alternatives, which follows this section. Because the current plan was not explicitly developed using the coarse-filter, fine-filter approach (a key tenet of the species diversity requirements under the 2012 rule), alternative 1 would be largely limited to plan direction from the 1996 Amendment, and best management practices and site-specific mitigations done at the project level. All federally listed species require evaluation of site-specific projects to determine if consultation with USFWS is appropriate.

The current plan has numerous standards and guidelines that require the evaluation and protection of federally listed species. These were recently evaluated in the Biological Assessment for the Continued Implementation of the Land and Resource Management Plans for the Eleven National Forests and National Grasslands of the Southwestern Region (USDA FS 2011a, 2019a) and the resulting 2012 and 2019 Programmatic Biological Opinion (USDI FWS 2012a, 2019), referred to collectively as the BA-BO. Most standards and guidelines that have the potential to benefit wildlife in the current plan are also found in the action alternatives being evaluated in this final environmental impact statement in the form of desired conditions, guidelines, or management approaches. In many places, the current plan reiterates existing law, regulation, or policy, but these are incorporated by reference in the action alternatives and are considered more specifically at the project level.

Prescriptive (restrictive) standards and guidelines in the current plan make it difficult to apply adaptive management, as our understanding about management effects on ecosystems and wildlife changes. Adaptive management will be essential to effectively manage for climate change and invasive species in changing and uncertain conditions. Current direction for invasive species is primarily focused on noxious weeds. Climate change has the potential to affect all wildlife and plant species, and influences the likelihood of large-scale disturbance (e.g., fire and bark beetle outbreaks) across the landscape. Alternative 1 does not recognize climate change and offers limited guidance associated with management activities (e.g., salvage logging and blow down) related to such disturbance events. Guidance for salvage operations is general in nature and focuses more on the enhancement of timber production rather than an integrated approach that balances management with other resource values such as wildlife habitat. The forest would continue to follow existing law, regulation, policy, and best management practices to address species viability concerns in areas affected by large-scale disturbance.

There is no recommended wilderness under alternative 1.

Mexican spotted owl

Mexican spotted owl and its designated critical habitat is protected by the standards and guidelines included in the 1996 plan amendment (1986 Forest Plan, as amended). Projects and program activities implemented under the current plan may occur near or within Mexican spotted owl protected activity centers and within critical habitat. While the standards and guidelines provide protection for the owl and maintain their viability on the forest, activities may be permitted, authorized, or funded, which may negatively affect individuals or affect designated critical habitat. Direction for the owl and its habitat in the current plan directly incorporates guidance from the 1995 Recovery Plan. This guidance is no longer current and at times conflicts with newer direction and/or direction for other species such as northern goshawk. Mexican spotted owl guidance would take precedence over other species in protected and restricted areas and recommendations outlined in the Revised Recovery Plan (USDI FWS 2012b) would be followed. The Revised Recovery Plan recognizes large, stand-replacing wildland fire as the greatest risk to the species' persistence and encourages the use of fire and vegetation management as a restoration approach. This thinking has changed since the 1995 Recovery Plan was originally written. The Carson would continue to incorporate appropriate conservation

actions. See the Endangered Species Act section 7(a) (1) discussion above in the Effects Similar for All Alternatives for actions the forest continues to take to mitigate risk to the owl.

According to the BA-BO, the overall assessment of the 1986 Forest Plan, as amended, was positive for Mexican spotted owl. Analysis of the standards and guidelines concluded that programs within the Carson would not appreciably impact the primary constituent elements to the point that critical habitat for Mexican spotted owl is no longer functional. The assessment also found that forest management actions should increase the sustainability and resiliency of Mexican spotted owl habitat, particularly through fuels management and forest restoration actions, and that continued implementation of the 1986 Forest Plan, as amended, is not expected to further diminish the conservation contribution of critical habitat to recovery of Mexican spotted owl. The BA-BO concluded that continued implementation of the 1986 Forest Plan, as amended, would not likely jeopardize the continued existence of the Mexican spotted owl and is not likely to destroy or adversely modify designated critical habitat. Standards and guidelines for alternative 1 have not changed since the BA-BO was finalized and can largely be found under management prescriptions applicable to all areas for old growth and Mexican spotted owl (1996 Amendment, pages 87–91). Many of the standards and guidelines are redundant with the old 1995 recovery plan for the owl.

The 1986 Forest Plan, as amended, does not define specific desired fire regimes, or contain objectives for frequency of fire to maintain or improve stand structure, maintain or decrease fuel loads, or to achieve other resource benefits. With the continued lack of fire disturbance, the risk of losing frequent fire forest vegetation systems to stand-replacing wildfire and the resulting uncharacteristic open state increases over time. The potential loss of ecological condition components due to large, high-severity wildfires could have particularly negative effects on Mexican spotted owl.

Frequent fire forest, riparian, and aquatic systems are highly departed and trending away from reference conditions, this trend would continue ([Ecological Condition](#)). Alternative 1 would continue to maintain current rates of planned and unplanned natural ignition and mechanical vegetation treatment which would move those vegetation states toward desired conditions at a slower rate than any of the action alternatives for Mexican spotted owl. Mixed Conifer Frequent Fire would remain moderately departed under this alternative's desired condition after 15 years but would move closer to the desired state, changing from of departure of 64 percent to 54 percent. This would be a slight overall improvement from current conditions. Under the current plan, habitat for Mexican spotted owl is highly departed and trending away. For Mexican spotted owl, based on vegetation modeling (Vegetation Dynamics Development Tool), it is estimated that the amount of mixed conifer available for nesting and roosting would increase over 15 years from 16 percent to 25 percent (from 41,439 to 65,405 acres). This is less than any other alternative (see table 40 for all results by alternative).

While some individual owls could be impacted by actions on the forest, the alternative management activities would not adversely affect the viability of the species. Overall, species viability would be maintained. Beneficial impacts include improvements in nesting and roosting habitat.

Southwestern willow flycatcher

Southwestern willow flycatcher and its designated critical habitat is protected by the standards and guidelines for riparian habitat (management area 14 in the 1986 Forest Plan) and partially by standards and guidelines that were included in the 1996 plan amendment. Projects and program activities implemented under the 1986 Forest Plan, as amended, may occur near or within critical habitat. While the standards and guidelines provide protection for the southwestern willow flycatcher and maintain their viability on the forest, activities may be permitted, authorized, or funded which may negatively affect individuals or affect designated critical habitat.

According to the BA-BO 2012, the overall assessment of the 1986 Forest Plan, as amended, was positive for southwestern willow flycatcher. Analysis of the standards and guidelines concluded that programs within the Carson would not negatively impact the primary constituent elements to the point that critical habitat for

southwestern willow flycatcher is no longer functional. The biological opinion concluded that continued implementation of the 1986 Forest Plan, as amended, would not likely jeopardize the continued existence of southwestern willow flycatcher and is not likely to destroy or adversely modify designated critical habitat. Standards and guidelines for alternative 1 have not changed since the BA-BO 2012 was finalized and can largely be found under management prescriptions applicable to the riparian management area in the current 1986 Forest Plan.

The 1986 Forest Plan, as amended, does not contain objectives for riparian ecosystems to maintain or improve shrub structure, maintain or increase streambank cover, or to achieve other resource benefits. Riparian and aquatic systems are highly departed and trending away from reference conditions. This trend would continue under this alternative ([Aquatic and Riparian Ecosystems](#)). Alternative 1 would continue to maintain current rates of riparian habitat improvement, which would move those vegetation states toward desired conditions at a slower rate than any of the action alternatives.

While some individual southwestern willow flycatchers could be impacted by actions on the forest, the alternative management activities would not adversely affect the viability of the species. Overall, southwestern willow flycatcher species viability would be maintained. Beneficial impacts include improvements in nesting habitat.

Western yellow-billed cuckoo and New Mexico meadow jumping mouse

Western yellow-billed cuckoo and New Mexico meadow jumping mouse were listed as threatened and endangered in 2014. No critical habitat was designated for either of these species on the Carson. These species have not had consultation with USFWS for the 1986 Forest Plan, as amended, but any project that may have impacted these species have been consulted on with the USFWS.

Both the western yellow-billed cuckoo and New Mexico meadow jumping mouse are protected by standards and guidelines for riparian habitat (riparian management area) and partially by standards and guidelines that were included in the 1996 plan amendment. While the standards and guidelines provide protection for these species and maintain their viability on the forest, activities may be permitted, authorized, or funded which may negatively affect individuals. The 1986 Forest Plan, as amended, does not contain objectives for riparian ecosystems to maintain or improve shrub structure, maintain or increase streambank cover, or to achieve other resource benefits. Riparian and aquatic systems are highly departed and trending away from reference conditions, this trend would continue under this alternative ([Ecological Conditions](#)). Alternative 1 would continue to maintain current rates for riparian habitat improvement, which would move those vegetation states toward desired conditions at a slower rate than any of the action alternatives.

While some individuals could be impacted by actions on the forest, the alternative management activities would not adversely affect the viability of these two species. Overall, western yellow-billed cuckoo and New Mexico meadow jumping mouse species viability would be maintained.

Canada lynx

Canada lynx was listed as threatened in 2000. No critical habitat was designated for this species on the Carson. Canada lynx has not had consultation with USFWS for the 1986 Forest Plan, as amended, but any project that may have impacted this species has been consulted on with the USFWS.

Canada lynx are protected by standards and guidelines for spruce under 40 percent slopes, spruce over 40 percent slopes, and aspen habitat (management areas 1, 2, and 6) in the 1986 Forest Plan, as amended. While standards and guidelines provide protection for Canada lynx and maintain its viability on the forest, activities may be permitted, authorized, or funded which may negatively affect individuals. The 1986 Forest Plan, as amended, does not contain objectives for spruce-fir or aspen vegetation communities. Spruce-fir vegetation community is currently lowly departed from reference condition, and the amount of spruce-fir forest is not expected to change under this alternative. Canada lynx that depend on ecological condition of spruce-fir forest, viability would be maintained through plan components that minimize risk for disturbance.

While some individuals could be impacted by actions on the forest, the alternative management activities would not adversely affect the viability of this species. Overall, Canada lynx species viability would be maintained.

Summary

In summary, alternative 1 has general direction to protect the viability of federally listed species. However, plan direction is based on outputs rather than outcomes, and fails to address current scientific thinking on the use of wildland fire and vegetation management as a way to promote ecological integrity, resilience, and wildlife diversity. Projects and activities would be guided by agency direction for managing federally listed species and direction to manage regional forester's sensitive species. While some individuals could be impacted by actions on the forest, the alternative management activities would not adversely affect the viability of federally listed species. Overall, federally listed species viability would be maintained.

Alternative 1 fails to address or poorly addresses the following over the life of the plan:

- Restoration would not happen at the pace and magnitude needed to have a marked effect on ecological resilience in a timely manner.
- Climate change, connectivity, and noxious invasive weeds are not explicitly recognized or incorporated.
- There is conflicting management direction for some species (e.g., northern goshawk and Mexican spotted owl).
- Monitoring plan lacks integration across resource areas, was not designed with the concept of adaptive management, and does not consider key ecological conditions for species of conservation concern.
- There is no clear direction for watershed improvement or overall riparian health.
- There is no clear direction for specific plant species improvement or how to improve soil condition.
- Not based on current and emerging best available scientific information.

Environmental Consequences for Federally Listed Species Common to Alternatives 2, 3, 4, and 5

Action alternatives 2, 3, 4, and 5 are more strategic in nature and integrated than alternative 1. All action alternatives were developed using the coarse-filter/fine-filter approach to develop plan components to support at-risk species, which includes federally listed species, from the 2012 Planning Rule (appendix H). This approach is critical in enabling the adaptive management feedback loop between the plan and the plan monitoring program and would help ensure that the ecological conditions for federally listed species are maintained and would provide for their persistence. All action alternatives include plan direction designed to maintain the diversity of plant and animal communities and support persistence of native species within the plan area, subject to Forest Service authority and the inherent capability of the plan area.

Substantive differences among action alternatives include six place-based management areas each having their own set of plan components. Other substantive differences between alternatives 2, 3, 4, and 5 that could impact federally listed species include the amount of recommended wilderness being proposed, the role of mechanical treatments and wildland fire as restoration tools, the amount of riparian/aquatic systems restored, and the amount of roads maintained or decommissioned for ecosystem health. Current science recognizes both wildland fire and vegetation management as tools through which ecological integrity and resilience can be managed (C. Miller and Aplet 2016; Reynolds et al. 2013). The action alternatives more proactively incorporate this thinking than alternative 1. All action alternatives would provide for a substantial increase in both prescribed fire and unplanned natural ignitions that are managed for resource benefits. This would have positive effects for Mexican spotted owl that use frequent fire forest as well as New Mexico meadow jumping mouse, the western yellow-billed cuckoo, and southwestern willow flycatcher that use riparian vegetation communities that can be affected by hydrology and sedimentation. The action alternatives also make better use of partnerships and collaboration to maintain ecosystem integrity and resilience. Current

science suggests that conservation partnerships are becoming increasingly important to adaptively manage for climate change (Monahan and Theobald 2018).

Adaptive management will be essential to effectively manage for climate change and associated impacts from disturbance events, livestock grazing, and invasive species in changing and uncertain conditions. The action alternatives include a monitoring plan designed to better inform the effects and effectiveness of management and progress toward desired conditions. Alternatives 2, 3, 4, and 5 better recognize and address the negative effects nonnative invasive species and disease can have on ecosystem integrity and biological diversity. Direction for invasive species was updated and expanded to recognize the threats to ecosystem resilience from all nonnative invasive aquatic and terrestrial plants and animals likely to cause harm to ecosystems. Finally, climate change may push rare and endemic species to the limits of their range and evolutionary capacity. This is expected to be especially significant in the Southwest, an area already affected by long-term drought. The action alternatives recognize and include plan components to help address that threat and to reduce the risk of removing ecological conditions important for federally listed species.

Recommended wilderness is proposed under alternatives 2, 4, and 5 (table 36). Recommended wilderness beneficially affects federally listed species through its primitive management, which minimizes disturbance and provides habitat connectivity. However, the Carson would also be more limited in its ability to treat these areas and would rely on wildland fire as its main restoration tool. Limiting the ability to treat these areas may leave these areas vulnerable to large, stand-replacing wildfire and cause these areas to become more departed in the future. More departed ecological conditions in the future may negatively affect federally listed species dependent on this habitat. Alternative 2 identifies 9,189 acres for recommended wilderness, alternative 4 identifies 45,473 acres, and alternative 5 would include the most recommended wilderness (67,996 acres).

Table 36. Acres of recommended wilderness by alternative

Alternative	Proposed Recommended Wilderness acres
1	0
2	9,189
3	0
4	45,473
5	67,996

Explicit forestwide plan direction that includes beneficial language to mitigate negative impacts on federally listed species and wildlife, in general, for climate change, nonnative invasive species, disease, and connectivity, which are missing from alternative 1, include but are not limited to plan components found in table 37 to table 39 list plan components that are beneficial at mitigating impacts from climate change, nonnative invasive species, disease, and connectivity included in alternatives 2 through 5. For full plan language see appendix H in volume 2 of the FEIS.

Table 37. Nonnative invasive species and disease beneficial plan language to mitigate impacts included in alternatives 2 through 5

Plan Code	Plan Code	Plan Code	Plan Code
FW-VEG-DC 11	FW-WSW-WB-S-1	FW-NIS-S-1	FW-FIRE-G 2
FW-SL-G 5	FW-WSW-RMZ-SNS-S-1	FW-NIS-G-1	FW-FIRE-G 3
FW-WSW-DC 2	FW-CAM-G-2	FW-NIS-G-5	DA-WILD-DC-2
FW-WSW-RMZ-STM-S 1	FW-NIS-DC-1	FW-GRZ-DC-4	MA-JICMA-G-9

Table 38. Connectivity beneficial plan language to mitigate impacts to wildlife included in alternatives 2 through 5⁴

Plan Code	Plan Code	Plan Code	Plan Code
FW-VEG-DC-5	FW-WSW-RMZ-STM-DC-3	FW-WFP-DC-7	FW-WFP-G-6
FW-VEG-DC-10	FW-WFP-DC-2	FW-WFP-DC-9	FW-GRZ-S-2
FW-WSW-DC-4	FW-WFP-DC-5	FW-WFP-G-3	FW-TFA-G-7
FW-WSW-RMZ-DC-5	FW-WFP-DC-6	FW-WFP-G-4	FW-TFA-G-8

Table 39. Climate change beneficial plan language to mitigate impacts to wildlife included in alternatives 2 through 5

Plan Code	Plan Code
FW-VEG-DC-2	FW-WSW-RMZ-DC-7
FW-VEG-DC-3	FW-WSW-RMZ-STM-DC-1
FW-VEG-DC-5	FW-WSW-RMZ-WB-DC-1
FW-VEG-DC-14	FW-WSW-RMZ-SNS-DC-1
All Vegetation Management Approach 2	FW-GRZ-DC-3
FW-WSW-DC 2	

These plan components would be beneficial for all wildlife, plant, and aquatic species but especially those species that depend on riparian systems (e.g., southwestern willow flycatcher, western yellow-billed cuckoo, and New Mexico meadow jumping mouse), frequent-fire adapted ecosystems (e.g., Mexican spotted owl and goshawk), aquatic systems (e.g., Rio Grande cutthroat trout), endemic species/species with restricted distributions, and species that move across large landscapes and use habitat at multiple spatial scales (e.g., elk and deer). These plan components support resilient and resistant ecosystems and watersheds, which would reduce negative effects for species from climate change and would give wildlife species the best opportunity to adapt to changing conditions. This type of plan language, which is included in the four action alternatives, is not explicitly called out under alternative 1 and should have a more positive effect on all federally listed species.

All four action alternatives reference the most current recovery plans for listed species, which would allow them to adapt to changing ideas and thinking as new science emerges and the recovery plans are updated over time. This is a key difference compared to alternative 1, which sometimes references outdated recovery plans and scientific information. Plan components under the action alternatives, which incorporate recommendations from approved recovery plans and support a more adaptive approach based on the best available science, include:

- FW-VEG-G 1 and FW-WFP-G 1 Management activities and special uses occurring within federally listed species' habitat should integrate habitat management objectives and species protection measures from the most recent approved USFWS recovery plan, to maintain the persistence or contribute to the recovery of that species.
- FW-VEG-G 2 and FW-WFP-G 2 Where the Forest Service has entered into a signed conservation agreement that provides guidance on activities or actions to be carried out by the Carson, those activities or actions should be undertaken consistent with the guidance found within the Conservation Agreement, to maintain the persistence or contribute to the recovery of federally listed species and persistence of species of conservation concern.
- FW-VEG-G 3 Vegetation should provide for at-risk species' habitats, by minimizing disturbance, providing recovery strategies, and managing for desired levels of key structural elements (e.g., large old

⁴ See also Final Environmental Impact Statement Volume 2 Appendix H.

trees and snags, downed woody debris, denser vegetation structure, and soil structure) important for nesting, rearing, breeding, foraging, dispersal, and other life history needs, to maintain the persistence or contribute to the recovery of at-risk species.

Additional plan components which would support species viability for Mexican spotted owl, Canada lynx, New Mexico meadow jumping mouse, Yellow billed cuckoo, and southwestern willow flycatcher are described in detail below.

Mexican spotted owl

- Key ecological conditions: Structurally diverse mature forests (seral state), conifer forest, structural heterogeneity, interlocking canopy, large tree retention, tons per acre of coarse woody debris, and snag density.
- Key threats: Risk of loss of ecological condition and habitat fragmentation of Frequent Fire Forest from wildfire outside the natural range of variability; vegetation management and fire (both unplanned natural ignition and prescribed), fuelwood collection, ungulate grazing, recreation, natural disturbance (e.g., insect outbreaks, drought), and climate change.

Mexican spotted owl would benefit primarily from objectives that move highly-departed frequent fire forest toward a more desired state. The objectives and effects differ across the action alternatives and the total amount of ecological condition moved toward desired conditions over the 15-year life of the plan varies across alternatives. The differing amounts of ecological condition improved are highlighted in the individual sections for each alternative in their respective vegetation sections. Mexican spotted owls need diverse forest structure, old-growth components, and are also dependent on large trees, coarse woody debris, snags, and tree-related components for roosting, foraging, and nesting. Downed, woody material and logs provide important ecological condition for small mammalian prey species. In addition to the components described above, Mexican spotted owl would also benefit from a number of ecosystem-level plan components which would protect these key ecological conditions.

Coarse filter

Coarse-filter plan components that would benefit Mexican spotted owl that depend on Forested Ecosystems include desired conditions to maintain appropriate structure, composition, and function at the landscape- (1,000 to 10,000 acres or more), mid- (100 to 1,000 acres) and fine-scales (less than 10 acres). Forest that have departed structure also have departed fire regime condition class. Restoring vegetation structure in frequent fire forests through vegetation management and fuels reduction projects will improve fire regime condition class and reduce the risk of stand replace fire. Desired conditions that incorporate varying structural stages, including uneven-aged forest with openings and occasional even-aged structure with large snags and abundant understory (e.g., coarse woody debris, logs), and old-growth components would guide the implementation of forest management activities that would move Frequent Fire Forest toward a more favorable departure and trend from that which currently exists, while reducing fire risk. The full range of life stage needs for Mexican spotted owl (e.g., fledging, nesting, dispersal, roosting), as well as conditions that would support an adequate prey base for foraging are provided for at the landscape (FW-VEG-MCD-DC 1-2, 4-5, FW-VEG-PPF-DC 1-2, FW-VEG-PPF-DC 4-7); mid (FW-VEG-MCD-DC 8-11, FW-VEG-PPF-DC 7-10); and fine scales (FW-VEG-MCD-DC 15, 17, and 18, FW-VEG-PPF-DC 15-18). There are also coarse-filter plan components to maintain appropriate levels of old trees, snags, nesting structures (e.g., witches brooms), and downed wood at multiple spatial scales for Mexican spotted owl. Forestwide desired conditions for the different vegetation community include the landscape (FW-VEG-DC 1-4; FW-VEG-G 3 and 4; FW-VEG-MCW-DC 4-6; FW-VEG-MCD-DC 4-6; FW-VEG-PPF-DC 5-8) and mid scales (FW-VEG-MCD 13; FW-VEG-PPF-DC 11).

Where Gambel's oak and other hardwoods occur as a component in conifer forest, desired conditions (FW-VEG-MCD-DC 13 and FW-VEG-PPF-DC 11) would promote their retention during project design to

promote canopy cover and moister site conditions for small mammals, plants and insects. Retention of oaks would promote biodiversity and abundant prey for foliage gleaners as well as apex predators.

Additional coarse-filter plan components under the Wildland Fire Management resource area promote endemic levels of disturbance, natural fire regimes, and restoration activities that would allow all Frequent Fire Forest to be resilient in the face of climate change, drought, and other disturbance. These include: (FW-FIRE-DC 1-2; FW-FIRE-G 1, 3, 7). A forestwide component specific to disturbances and climate change in the all Vegetation section (FW-VEG-DC 2) further supports ecosystem resiliency.

The Sustainable Forestry and Forest Products resource area would ensure that private and commercial timber harvest is used as a restoration tool and desired conditions for this resource (FW-FFP-DC 4-5) would ensure these types of activities are done in a way that enhances Mexican spotted owl ecological condition requirements, particularly with regard to snags and dying trees. Within this section are vegetation management standards (FW-FFP-S 1 and 2) that would mitigate habitat disturbance and damage that might occur as a result of timber harvest, so that watershed conditions are protected, and the ecological needs of Mexican spotted owl are maintained. Guidelines (FW-FIRE-G 7 and 8) would also protect or enhance Mexican spotted owl habitat, including critical habitat, from Wildland Fire activities.

There are also plan components that balance the needs of multiple use with wildlife species that need large trees and snags (FW-REC-G 1). Guideline 1 in Recreation would minimize impacts to these habitat features in developed and dispersed recreation sites. Ponderosa Pine includes guideline FW-VEG-PPF-G 1, that vegetation treatments should be designed to assure continuous recruitment of old-growth characteristics across the landscape over time.

Livestock management has the potential to affect habitat for spotted owl prey species. A desired condition (FW-GRZ-DC-4) and a standard (FW-GRZ-S-1) for livestock grazing strive for compatibility with ecological functions and processes (such as water infiltration, wildlife habitat, soil stability, and natural fire regimes) and resilient ecosystems that are consistent with plan components for fire-adapted ecosystems and riparian habitat. In addition, desired condition (FW-GRZ-DC-5) emphasizes native plant communities with a diversity of shrubs and understories of grasses. These components promote understory and grassland to help improve habitat conditions for spotted owl prey species across the Carson. These plan components would complement and reinforce desired conditions in ponderosa pine and frequent fire mixed conifer vegetation types and help to ensure that understory development is balanced with grazing management and the needs of the owl.

A guideline (FW-GRZ-G-1) would balance forage use with desired ecological conditions and livestock grazing during permit renewals and development of annual operating instructions. In riparian management zones a guideline (FW-GRZ-G-2) would ensure that livestock grazing is done in a way that support riparian desired conditions.

Guidelines for soils would ensure sufficient levels of woody debris are maintained during projects and would mitigate negative effects that occur from ground-disturbing activities that cause soil loss, erosion, and compaction. This would also protect soils from scarification from prescribed burns. (FW-SL-DC 1-2, FW-SL-G 1, FW-FIRE-G 9).

Fine filter

In addition to the ecosystem-based components highlighted above, a number of fine filter, species-specific, plan components were added to address the needs of Mexican spotted owl.

Fine-filter plan components (FW-VEG-MCD-DC 11 and FW-VEG-PPF-DC 13) were added to meet the breeding, foraging, and roosting needs of Mexican spotted owl at the mid-scale. The following guidelines were added to mitigate disturbance from project management activities that might cause disturbance and nest failure during the breeding season for Mexican spotted owl:

- FW-VEG-G 3 Vegetation should provide for at-risk species' habitats, by minimizing disturbance, providing recovery strategies, and managing for desired levels of key structural elements (e.g., large old trees and snags, downed woody debris, denser vegetation structure, and soil structure) important for nesting, rearing, breeding, foraging, dispersal, and other life history needs, to maintain the persistence or contribute to the recovery of at-risk species.
- FW-WFP-G 3 Management activities should avoid disturbance at known active raptor nests and fledging areas, to maintain the persistence or contribute to the recovery of at-risk species. Timing restrictions, adaptive percent utilizations, distance buffers, or other means of avoiding disturbance should be based on the best available scientific information, as well as on site-specific factors (e.g., topography and available habitat).⁵

Finally, plan components were added to address the tree features utilized by Mexican spotted owl. These include:

Landscape-Scale Desired Conditions (1,000 to 10,000 plus acres)

- FW-VEG-MCW-DC 6, MCD-DC 6, and PPF-DC 7 Dwarf mistletoe infestations may be present in stands with a Douglas-fir or spruce component, but rarely in other tree species. Infestation size, severity, and amount of mortality varies among infested stands. Witches' brooms may be scattered throughout the infestations, providing structural diversity in the stand and improved foraging and nesting habitat for wildlife species, such as small mammals (e.g., tree squirrels) and raptors (e.g., goshawks and red-tailed hawks).
- FW-VEG-PPF-G 1 Vegetation treatments should be designed such that structural stages and age classes are proportionally represented to assure continuous recruitment of old-growth characteristics across the landscape over time.
- FW-VEG-MCW-G 1, MCD-G 1, and PPF-G 3, Slash piles should be retained across the landscape for several years, to increase small mammal occupancy in areas where coarse woody debris is deficient and provide nesting habitat and cover for associated wildlife species (e.g., turkeys, birds, small mammals, reptiles, and invertebrates).

Management Approaches that would support Mexican spotted owl include:

- Management Approaches for All Vegetation Communities 1
- Management Approaches for All Vegetation Communities 4: When thinning, consider leaving snags, downed logs, and other woody components that collect drifting seeds, provide shade, reduce surface temperatures, retain moisture, and increase forage for ungulate grazing.
- Management Approaches for All Vegetation Communities 6: Consider working closely with the U.S. Fish and Wildlife Service (USFWS) to provide for federally listed species' habitats, through minimizing disturbance, providing recovery strategies, and managing for desired levels of key structural elements (e.g., large old trees and snags, downed woody debris, denser vegetation structure, and soil structure) important for nesting, rearing, breeding, foraging, and dispersal.

Southwestern willow flycatcher, western yellow-billed cuckoo, and New Mexico meadow jumping mouse

- Key Ecological Conditions: diverse herbaceous and shrub riparian composition and structure.
- Key Threats: Loss, modification, and fragmentation of riparian breeding habitat, along with a host of other factors including loss of wintering habitat and brood parasitism by the brown-headed cowbird (USDI FWS 2020b). Habitat loss and degradation are caused by a variety of factors, including urban,

⁵ Birds known to have established nests near preexisting human activities are assumed to be tolerant of the level of activity present when the nest was established.

recreational, and agricultural development, water diversion and groundwater pumping, channelization, dams, and excessive livestock grazing.

Riparian habitat includes wetlands and forested riparian (i.e., willow, cottonwood, and alder) areas surrounding seeps/springs, perennial streams, lakes, and other water features. Riparian habitat occupies a very small portion of the forest and ranges from low to highly-departed, depending on elevation. The southwestern willow flycatcher, the western yellow-billed cuckoo, and New Mexico meadow jumping mouse that utilize this type of ecological condition would benefit from plan objectives that move riparian, including wetlands, ecological conditions toward the desired state. The objectives and effects differ across action alternatives and the total amount of ecological condition moved toward desired conditions over the 15-year life of the plan varies for each habitat type across alternatives. The differing amounts of ecological condition improved are highlighted for each alternative in their respective sections.

Plan components that would benefit southwestern willow flycatcher, the western yellow-billed cuckoo, and New Mexico meadow jumping mouse that depend on these vegetation communities can be found under the Watershed and Water, Riparian Management Zones, Wetland Riparian, Forest and Shrub Riparian, Nonnative Invasive Species, Wildlife, Fish, and Plant, All Vegetation, and Fire and Fuels sections of the action alternatives. Additional plan components, which balance multiple use with wildlife needs, can be found under the Sustainable Grazing and Livestock Management, Roads, and Mineral and Mining sections.

Coarse Filter

Desired conditions within the Watershed, Riparian Management Zone, Wetland Riparian, and Forest and Shrub Riparian resource sections (FW-WSW-DC 1-3; FW-WSW-RMZ-DC 1-8; FW-WSW-RMZ-WR-DC 1-3; FW-WSW-RMZ-FSR-DC 1-6) would move these systems toward proper functioning condition, while balancing multiple uses with ecological integrity. These components would help to minimize water diversions and improve hydrologic function, while maintaining systems that are resilient to climate change and associated disturbances, such as fire. Watershed guideline FW-WSW-G 1 would ensure that best management practices are applied to every site-specific project that has the potential to affect watershed conditions. Several standards and guidelines (FW-WSW-G 2; FW-WSW-RMZ-G 1-4; FW-WSW-RMZ-WR-S 1-3) would mitigate adverse effects from road construction or reconstruction, which can cause sedimentation, and would also rehabilitate in-stream structures, which could improve hydrologic function.

Livestock grazing can trample, alter plant community structure, species composition, relative abundance of species, vegetative density, and alter stream channel morphology for these riparian species. Plan components for the sustainable rangelands and livestock grazing program areas (FW-GRZ-DC-4-6; FW-GRZ-S-1; FW-GRZ-G-2-3) emphasize that livestock grazing within riparian management zones must be compatible with ecological function and the needs of at-risk species, and that desired conditions for riparian vegetation and proper stream channel morphology and floodplain function are sustained. These plan components would be beneficial by balancing multiple use with healthy riparian systems. Over the last decade, the Carson range staff has worked with partners and permit holders to manage grazing pressure on sensitive areas (such as critical areas and riparian areas).

Standards for Sustainable Forestry and Forest Products (FW-FFP-S 1-2) would protect the ecological integrity of watershed conditions by minimizing potentially adverse effects that could cause soil erosion and sedimentation during timber harvest operations. Plan components for the Sustainable Rangelands and Livestock Grazing, Riparian Management Zones resource (FW-GRZ-DC 4-6; FW-GRZ-S 1, FW-GRZ-G 1-3, 5; FW-WSW-RMZ-G 2, FW-WSW-RMZ-STM-DC 11; FW-WSW-RMZ-WB-DC 6) would ensure associated management activities are compatible with ecological function and supportive of diverse native plant communities, including in wetland and riparian areas/riparian management zones.

Several guidelines (FW-GRZ-G 3-5) prevent the construction of new structures in riparian management zones and minimize potentially adverse effects that the construction of such structures may have on soils and hydrologic function of natural spring sources.

Desired condition 1 within the Minerals and Mining resource section would minimize impacts to surface and groundwater resources while facilitating the development of minerals. Guideline FW-WSW-RMZ-G 2 under the Riparian Management Zone resource section would protect riparian areas from streambed and flood plain alteration, while standards and guidelines for the Transportation and Forest Access and Special Use resource sections (FW-TFA-G 2-4; FW-SU-S 2; FW-SU-G 4) would minimize disturbance (e.g., water flow, sedimentation) from the construction of roads and energy corridors by including mitigations to limit disturbance during project-level design.

Nonnative plant species can outcompete native species, causing reduction in suitable habitat for Southwestern willow flycatcher, western yellow-billed cuckoo, and New Mexico meadow jumping mouse and alterations in riparian function, while nonnative invasive animals and pathogens can cause direct mortality and predation. These threats are reduced through plan components in the Nonnative Invasive Species and Wildland Fire Management resource sections of the plan through desired conditions, standards and guidelines (FW-NIS-DC 1; FW-NIS-S 1-2; FW-NIS-G 1, 3, 5-6; FW-FIRE-G 2-3) that minimize impacts to wildlife in riparian areas, and would also prevent pathogen transmission.

Fine Filter

Plan components were specifically added to ensure vegetation requirements needed by southwestern willow flycatcher, western yellow-billed cuckoo, and New Mexico meadow jumping mouse are not removed during project level activities, and that multiple uses (grazing, vegetation treatment and recreation) minimize impacts on southwestern willow flycatcher, western yellow-billed cuckoo, and New Mexico meadow jumping mouse.

- FW-WSW-RMZ-DC 2 Riparian vegetation, particularly native species, support a wide range of vertebrate and invertebrate animal species. There is adequate recruitment and reproduction to maintain diverse native plant species composition indicative of the soil moisture conditions for the site.
- FW-WSW-RMZ-WR-DC 1 Necessary soil, hydrologic regime, vegetation, and water characteristics of WR sustain the system's ability to support unique physical and biological attributes and the diversity of associated species (e.g., shrews and voles). Soils' ability to infiltrate water, recycle nutrients, and resist erosion is maintained and allows for burrowing by at-risk species.
- FW-WSW-RMZ-FSR-DC 4 Riparian forest vegetation provides nesting and foraging habitat for Neotropical migrant birds, raptors, and cavity-dependent wildlife.
- FW-WSW-RMZ-FSR-DC 5 Woody riparian species are reproducing and are structurally diverse with a range of seral states present.
- FW-WSW-RMZ-FSR-DC 12 Dense willow conditions (70 percent cover or greater) are retained for at-risk species habitat.

The following guidelines were added to mitigate disturbance from project management activities to southwestern willow flycatcher, western yellow-billed cuckoo, and New Mexico meadow jumping mouse:

- FW-WSW-RMZ-FSR-G 1 Connectivity within FSR should be maintained and enhanced by protecting ecological functions, tree density and growth, and native understory, to reduce the risk of predation and nest parasitism, and to provide habitat for at-risk and other wildlife species.
- FW-WSW-RMZ-FSR-G 3 Large mature cottonwood trees should be protected from management activities that could degrade them as suitable habitat for at-risk species. Projects occurring in these areas should incorporate restoration prescriptions, to ensure persistence of this habitat type.
- FW-WSW-DC 6 Watersheds support multiple uses (e.g., timber, recreation, grazing) with no long-term decline in ecological conditions. Short-term impacts occur only when they serve to improve conditions over the life of the plan.

- FW-WSW-RMZ-WR-S 2 In wetland areas, management activities, permitted uses, and structural developments (e.g., livestock water gaps, pipelines, or other infrastructure) may only occur when necessary to move toward water, soils, and vegetation desired conditions or to protect life and property.
- FW-GRZ-S 1 Livestock management shall be compatible with capacity and address ecological resources (e.g., forage, invasive plants, at-risk species, soils, riparian health, and water quality) that are departed from desired conditions, as determined by temporally and spatially appropriate data.
- FW-FFP S 2 Timber harvest shall only occur where soil, slope, and watersheds will not be irreversibly damaged, and protection must be provided for streams, streambanks, shorelines, lakes, wetlands, other waterbodies, fish, wildlife, recreation (including trails), and aesthetic resources.
- FW-REC-G 1 Recreation activities should be compatible with and managed adaptively to minimize impacts to at-risk species and ecological desired conditions, including in riparian management zones (e.g., along streams, around seeps, springs, lakes, and wetlands).

A management approach that would support listed species in Riparian includes:

- Management Approaches for All Vegetation Communities 6: Consider working closely with the U.S. Fish and Wildlife Service (USFWS) to provide for federally listed species' habitats, through minimizing disturbance, providing recovery strategies, and managing for desired levels of key structural elements (e.g., large old trees and snags, downed woody debris, denser vegetation structure, and soil structure) important for nesting, rearing, breeding, foraging, and dispersal.

Canada lynx

- Key Ecological Conditions: Structurally diverse mature forests (seral state), interlocking canopy, large tree retention, tons per acre of coarse woody debris, and the amount and distribution of dense horizontal cover providing snowshoe hare habitat.
- Key Threats: Risk of loss of ecological condition and habitat fragmentation of high-elevation forest (SFF and MCW), from wildfire outside the natural range of variability and livestock grazing, vegetation management and fire (both unplanned natural ignition and prescribed), fuelwood collection, natural disturbance (e.g., insect outbreaks, drought), and climate change. Snow compaction from over-snow use.

Canada lynx need diverse forest structure and old-growth components and also need large trees and coarse woody debris for foraging of snowshoe hare. Conditions and trends in high-elevation forest did not raise significant concerns, therefore no objectives were developed for them. The Carson has, however, identified desired conditions for high-elevation forest and would implement management to make progress toward desired conditions as capacity allows. The amount of high-elevation forest is not expected to change under any alternative. Viability of Canada lynx would be maintained through plan components that minimize risk for disturbance and maintain ecological condition.

In addition to the components described above, Canada lynx would also benefit from a number of ecosystem level plan components which would protect these key ecological conditions and minimize risk of disturbance.

Coarse filter

Coarse-filter plan components that would benefit Canada lynx and its high-elevation forest ecological needs include desired conditions to maintain appropriate structure, composition, and function at the landscape (1,000 to 10,000 acres or more), mid (100 to 1,000 acres) and fine-scales (less than 10 acres). Forest that have departed structure also have departed fire regime condition class. Restoring vegetation structure in Frequent Fire Forest while reducing fire risk through vegetation management and fuels reduction projects will improve fire regime condition class and reduce the risk of stand replace fire. Desired conditions that incorporate varying structural stages including uneven-aged forest with openings, old growth, and abundant understory (e.g., coarse woody debris, logs) would guide the implementation of forest management activities

that would maintain high-elevation forest current, favorable departure, and trend. The full range of life stage needs for Canada lynx (e.g., foraging, hiding, denning, and dispersal), as well as conditions that would support snowshoe hare for foraging, are provided for at the landscape (FW-VEG-SFF-DC 1-4, FW-VEG-MCW-DC 1-2, FW-VEG-MCW-DC 4-5); mid (FW-VEG-SFF-DC 8-10, FW-VEG-MCW-DC 8-9); and fine scales (FW-VEG-SFF-DC 16, FW-VEG-MCW-DC 15).

Additional coarse-filter plan components under the Wildland Fire Management resource area promote endemic levels of disturbance, natural fire regimes and restoration activities that would allow all high-elevation forest to be resilient in the face of climate change, drought, and other disturbance. These include: (FW-FIRE-DC 1-2; FW-FIRE-G 1, 3, 7). A forestwide component specific to disturbances and climate change in the all Vegetation section (FW-VEG-DC 2) further supports ecosystem resiliency.

Both domestic and wild ungulate grazing is an historical and current use within portions of lynx range on the Carson. Throughout the Rocky Mountains, grazing has been a factor in the decline or loss of aspen as a seral species in subalpine forests (Ruediger et al. 2000). Aspen stands with a well-developed understory provide good-quality habitat for snowshoe hares and other potential lynx prey species, such as grouse. Domestic livestock, wild ungulates, or both may change the structure, composition, or both of native plant communities, thus changing their ability to support lynx and their prey. Livestock grazing can be a concern on vegetation structure and composition, particularly in riparian zones where aspen and willow provide important summer foraging habitat for a wider variety of prey species than during the winter periods.

A desired condition (FW-GRZ-DC-4) and a standard (FW-GRZ-S-1) for livestock grazing strive for compatibility with ecological functions and processes (such as water infiltration, wildlife habitat, soil stability, and natural fire regimes) and resilient ecosystems that are consistent with plan components for spruce-fir and aspen ecosystems. In addition, desired condition (FW-GRZ-DC-5 -6) emphasizes native plant communities with a diversity of shrubs, willows, and understories of grasses. These components promote understory and grassland to help improve habitat conditions for snowshoe across the Carson. These plan components would complement and reinforce desired conditions in spruce-fir and aspen ecosystems and help to ensure that understory development is balanced with grazing management.

A guideline (FW-GRZ-G-1) would balance forage use with desired ecological conditions and livestock grazing during permit renewals and development of annual operating instructions. In riparian management zones a guideline (FW-GRZ-G-2) would ensure that livestock grazing is done in a way that support riparian desired conditions.

The Sustainable Forestry and Forest Products resource area would ensure that private and commercial timber harvest is used as a restoration tool and desired conditions for this resource (FW-FFP-DC 4-5) would ensure these types of activities are done in a way that enhances Canada lynx ecological condition requirements. Within this section are vegetation management standards (FW-FFP-S 1 and 2) that would mitigate habitat disturbance and damage that might occur as a result of timber harvest so that watershed conditions are protected, and the ecological needs of Canada lynx are maintained. Guidelines (FW-FIRE-G 7 and 8) would also protect or enhance Canada lynx habitat, including critical habitat, from wildland fire activities.

There are also plan components that balance the needs of multiple use with wildlife species that need large trees and snags (FW-REC-G 1). Guideline 1 in Recreation would minimize impacts to these habitat features in developed and dispersed recreation sites. Guidelines within soil, vegetation, and fire (FW-SL-DC 1-2, FW-SL-G 1, FW-VEG-SFF-G 1, FW-FIRE-G 9) would ensure sufficient levels of woody debris are maintained during projects and would mitigate negative effects that occur from ground-disturbing activities and prescribed burns that cause soil loss, erosion, compaction, and scarification.

Fine filter

In addition to the ecosystem-based components highlighted above, a number of fine filter species-specific plan components were added to address mitigate disturbance and snow compaction from project management activities to Canada lynx:

- FW-VEG-G 3 Vegetation should provide for at-risk species' habitats, by minimizing disturbance, providing recovery strategies, and managing for desired levels of key structural elements (e.g., large old trees and snags, downed woody debris, denser vegetation structure, and soil structure) important for nesting, rearing, breeding, foraging, dispersal, and other life history needs, to maintain the persistence or contribute to the recovery of at-risk species.
- FW-VEG-WFP-DC 7 Species are free to extent possible from harassment and human disturbance at a scale that impacts vital functions (e.g., breeding, feeding, and rearing young) that could affect persistence of the species.
- FW-VEG-PPF-G 1 Vegetation treatments should be designed such that structural stages and age classes are proportionally represented to assure continuous recruitment of old-growth characteristics across the landscape over time.
- FW-VEG-MCW-G 1 Slash piles should be retained across the landscape for several years, to increase small mammal occupancy in areas where coarse woody debris is deficient and provide nesting habitat and cover for associated wildlife species (e.g., turkeys, birds, small mammals, reptiles, and invertebrates).
- FW-TFA-S 2 Over-snow use off of designated areas identified on the Carson's most updated over-snow vehicle use map is prohibited, except as authorized by law, permits, or orders, to protect public safety and ecological resources.

Management Approaches that would support Canada lynx include:

- Management Approaches for All Vegetation Communities 4: When thinning, consider leaving snags, downed logs, and other woody components that collect drifting seeds, provide shade, reduce surface temperatures, retain moisture, and increase forage for ungulate grazing.
- Management Approaches for All Vegetation Communities 6: Consider working closely with the U.S. Fish and Wildlife Service (USFWS) to provide for federally listed species' habitats, through minimizing disturbance, providing recovery strategies, and managing for desired levels of key structural elements (e.g., large old trees and snags, downed woody debris, denser vegetation structure, and soil structure) important for nesting, rearing, breeding, foraging, and dispersal.

Environmental Consequences for Federally Listed Species – Alternatives 2 and 5

Alternatives 2 and 5 retain relevant plan direction from alternative 1 but are more responsive to current science and thinking while addressing the core themes and significant issues explored during the plan revision process. The only difference between alternatives 2 and 5 is the amount of recommended wilderness, which was discussed in the effects common to all action alternatives. The primary difference between alternatives 2 and 5 and the other alternatives is the addition of three place-based management areas with their own plan components, variation among management objectives and restoration, and objectives for road management. All other plan components would remain the same as those listed under all action alternatives. In addition to the environmental consequences for all alternatives above, alternatives 2 and 5 would primarily differ from alternative 1 in the rate and magnitude of ecological condition restored for riparian-dependent species and species affected by frequent-fire adapted ecosystem treatment.

Mexican spotted owl

Frequent fire forest vegetation community is moderately to highly departed and trending away from reference conditions ([Frequent Fire Forest](#)). Alternatives 2 and 5 would increase the current rate of mechanical treatment (27,500 to 60,000 acres during each 10-year period) and the current rate of wildland fire (100,000 to 165,000 acres during each 10-year period).

After 15 years, desired conditions for mixed conifer would remain moderately departed but would move closer to the desired state, changing from departure of 64 percent to 43 percent. While ponderosa pine would

remain highly departed, it would move closer to the desired state, changing from 92 percent to 59 percent. This would be an improvement over alternative 1 for Mexican spotted owl that depend on frequent fire adapted ecosystems.

For Mexican spotted owl, based on Vegetation Dynamics Development Tool modeling under alternatives 2 and 5, it is estimated that the amount of frequent fire forest available for nesting and roosting would increase in 15 years from 16 percent to 34 percent (41,439 acres to 87,347 acres). This is more than alternative 4, but less than alternative 3 (see table 40 for all results by alternative).

Southwestern willow flycatcher, western yellow-billed cuckoo, and New Mexico meadow jumping mouse

Watershed resources, riparian, and aquatic habitats are highly departed and are trending away from reference conditions. Alternatives 2 and 5 set objectives to restore structure and function of at least 200 to 300 acres of riparian areas annually, and objectives to restore, enhance, or maintain 100 to 150 stream miles, and 10 to 20 springs during each 10-year period. This also includes objectives (FW-TFA-O 1-3) and guidelines (FW-TFA-G 2 and 7) to maintain or decommission roads to improve watershed health. These plan components would move riparian ecological condition across the forest closer to a desired state. Moving toward desired conditions would improve ecological conditions necessary to maintain viability for southwestern willow flycatcher, the western yellow-billed cuckoo, and New Mexico meadow jumping mouse by decreasing sedimentation and improving seral state distribution, surface flow timing and duration, and repairing disconnected floodplains. Plan components discussed under all action alternatives would help to offset any potentially adverse effects from these actions. Desired conditions would be achieved at a faster rate than alternative 1 but slower than the other alternatives. Alternatives 2 and 5 would increase outcomes in terms of improving stream health, riparian habitat, and wetland integrity ([Environmental Consequences for Watersheds and Water Resources](#)) compared to alternative 1.

Canada lynx

Conditions and trends in high-elevation forest did not raise significant concerns, therefore, no objectives were developed for them. The Carson has, however, identified desired conditions for high-elevation forest and would implement management to make progress toward desired conditions as capacity allows. The amount of high-elevation forest is not expected to change under any alternative. Plan components discussed under all action alternatives would help to offset any potentially adverse effects to high-elevation ecological condition needed for Canada lynx.

All Listed Species

Under alternatives 2 and 5, increased levels of mechanical and restoration treatments from objectives would cause increased temporary ground disturbance to federally listed species. However, within these alternatives, plan components specifically addressing soil and ground disturbance are found throughout all sections of the plan (FW-VEG-G 2, FW-SOIL-G-1 and 2, FW-WSW-DC 2, FW-GRZ-G 4-5, FW-TFA-G 1-2, FW-TFA-G 9, FW-REC-G 1, FW-FFP-S 2, FW-FFP-G-3, and FW-SU-G-1-3). There are also plan components and objectives (FW-TFA-O 1, FW-TFA-G 3 and 4, and FW-REC-O 6) within these alternatives that seek to rehabilitate areas that are disturbed. The entire suite of plan components addressing this threat can be found in appendix H.

The primary plan components in management areas, which differ from alternatives 3 and 4, include desired conditions and guidelines for Grassland Maintenance Management Area (all ranger districts), Jicarilla Natural Gas Management Area (Jicarilla Ranger District), Valle Vidal Management Area (Questa Ranger District), and San Antonio Management Area (Tres Piedras Ranger District). Grassland Maintenance Management Area desired condition MA-GMMA-DC 1 preserves woodlands in a treeless state to promote forage production and would not impact any federally listed species.

Valle Vidal Management Area (MA-VVMA-DC 1, 2, 4, and 5) and San Antonio Management Area (MA-SAMA-DC 1, 3-4) are managed for multiple uses, focusing on the restoration and protection of diverse, resilient, biological communities for future generations, while providing a quality backcountry outdoor recreation experience. Valle Vidal and San Antonio Management Areas limit development and road construction. Existing closed and non-system roads would continue to naturalize and would diminish watershed and ecological condition impacts from sedimentation and habitat segmentation. Ecological condition improvement from limiting development and road construction would decrease disturbance to federally listed species found within these management areas. All plan components within these management areas would maintain species viability.

Mexican spotted owl

Determination: There could be some localized adverse impacts to Mexican spotted owl and its critical habitat, but overall, Mexican spotted owl species viability would be maintained. Beneficial impacts include a slight improvement in potentially suitable habitat in dry mixed conifer and ponderosa pine systems by increasing the amount of habitat in the desired seral states for breeding and foraging.

Canada lynx

Determination: While some individuals could be impacted by actions on the forest, the alternative management activities would not adversely affect the viability of the species. Overall, Canada lynx species viability would be maintained. Beneficial impacts include a slight decrease in disturbance and a slight improvement in connectivity by maintaining ecological condition and decreasing the number of roads.

Southwestern willow flycatcher, western yellow-billed cuckoo, and New Mexico meadow jumping mouse

Determination: While some individuals could be impacted by actions on the forest, the alternative management activities would not adversely affect the viability of the species. Overall, southwestern willow flycatcher, western yellow-billed cuckoo, and New Mexico meadow jumping mouse species viability would be maintained. Beneficial impacts include a slight improvement in watershed and riparian conditions.

Environmental Consequences for Federally Listed Species – Alternative 3

The primary difference between alternative 3 and the other alternatives is the addition of two place-based management areas (Grassland Maintenance Management Area and Off-Highway Vehicle Management Area) with their own unique plan components. The San Antonio and Valle Vidal Management Areas found in alternatives 2, 4, and 5 are not included in this alternative. Alternative 3 uses mechanical treatment, wildfire, and fuelwood collection to decrease risk from stand-replacing wildfire and to improve ecosystem function. All other plan components would remain the same as those listed under all action alternatives.

Alternative 3 has higher restoration objective acres than any other alternative for fire-adapted ecosystems and sustainability of springs, wetlands, and riparian areas (improved watershed health). An increased emphasis on restoration intensity emphasizes partnerships to get more work done on the ground to achieve desired conditions at a greater rate than the other alternatives. This should benefit Mexican spotted owl, southwestern willow flycatcher, western yellow-billed cuckoo, and New Mexico meadow jumping mouse that depend on fire-adapted and riparian ecosystems by improving ecological condition at a faster rate and intensity in areas that need it most.

Mexican spotted owl

Using mechanical treatments within frequent fire forest, there would be an increase to 65,000 to 130,000 acres treated during each 10-year period. Acres treated using prescribed fire would remain the same as alternatives 2 and 5 (100,000 to 165,000 acres during each 10-year period). Under alternative 3, in 15 years, desired conditions for mixed conifer would remain moderately departed but would move closer to the desired state, changing from a departure of 64 percent to 33 percent. This alternative would realize the

greatest overall improvement in ecological condition for Mexican spotted owl. Based on Vegetation Dynamics Development Tool modeling under alternative 3, it is estimated that the amount of frequent fire forest available for nesting and roosting would increase in 15 years from 16 percent to 35 percent (41,439 acres to 91,004 acres). This is the most of any alternative (see table 40 for all results by alternative).

The Developed Winter and Summer Resort Management Area comprises the permitted ski areas on the Carson. This management area is currently managed in an altered vegetative state from reference condition and would continue to be managed as such under alternative 3. However, under this alternative, the Developed Winter and Summer Resort Management Area would be expanded by 921 acres around the Sipapu Ski and Summer Resort. The current Sipapu permitted boundary is 215 acres and would remain this acreage under all alternatives except alternative 3 where it would likely be expanded through a separate analysis. Expansion of this boundary would allow alteration of current vegetation, thereby possibly decreasing Mexican spotted owl habitat, decreasing habitat connectivity for Mexican spotted owl, and would possibly increase ground disturbance and human intrusive disturbance from ski area development within the expanded part of this management area. Effects from the current permitted boundary for this management area are analyzed under Environmental Consequences Common to All Alternatives.

Southwestern willow flycatcher, western yellow-billed cuckoo, and New Mexico meadow jumping mouse

Watershed resources, riparian, and aquatic habitats are highly departed and are trending away from reference conditions. Alternative 3 sets the same objectives as alternatives 2 and 5 to restore structure and function of at least 200 to 300 acres of riparian areas annually, and objectives to restore, enhance, or maintain 100 to 150 stream miles and 10 to 20 springs during each 10-year period. These plan components would move riparian ecological condition across the forest closer to a desired state. However, widespread mechanical treatment under alternative 3 would result in the most ground disturbance, causing short-term impacts to soil stability and erodibility, with subsequent watershed impacts such as increased sedimentation being more likely. Moving toward desired conditions would improve ecological conditions necessary to maintain viability for southwestern willow flycatcher, western yellow-billed cuckoo, and New Mexico meadow jumping mouse by improving seral state distribution, surface flow timing and duration, and repairing disconnected floodplains. Desired conditions would be achieved at a faster rate than any other alternative, but this alternative would also have the greatest increase in sedimentation from ground disturbance than any other alternative.

Canada lynx

Conditions and trends in high-elevation forest did not raise significant concerns, therefore, no objectives were developed for them. The Carson has, however, identified desired conditions for high-elevation forest, and would implement management to make progress toward desired conditions as capacity allows. The amount of high-elevation forest is not expected to change under any alternative. Plan components discussed under all action alternatives would help offset any potentially adverse effects to high-elevation ecological condition needed for Canada lynx.

All Listed Species

Widespread mechanical treatment under alternative 3 would result in the most ground disturbance and associated effects to understory vegetation than any other alternative. Localized, short-term impacts to soil stability and erodibility, with subsequent watershed impacts such as increased sedimentation, would be more likely. There may be higher probability of localized invasive species distribution and establishment in disturbed areas. Increased sedimentation, increased ground disturbance, and increases in invasive species distribution would negatively affect federally listed species and their viability.

This alternative places more emphasis on human uses, therefore road maintenance is emphasized with the potential to increase road use. Temporary roads would be considered for inclusion into the system to support multiple use activities and access to the forest as an alternative to decommissioning. In addition, this

alternative proposes an Off-Highway Vehicle Management Area on the Camino Real Ranger District. The Off-Highway Vehicle Management Area would allow cross-country travel opportunities within the management area to provide challenging terrain for trials motorcycles and off-highway vehicle rock crawling. The added footprints of increased road activity and the proposed Off-Highway Vehicle Management Area would increase ground and soil disturbance and would increase intrusive human activities (vehicle noise) that would negatively impact federally listed species, especially Canada lynx.

Grassland Maintenance Management Area (forestwide) is also proposed under this alternative and effects from plan components for the management area would be the same as described for alternatives 2 and 5.

This alternative, with increased mechanical treatment, would move departed ecological conditions of frequent fire forest toward desired condition the fastest. However, the increased mechanical treatment, potential to increase road use, and the inclusion of the Off-Highway Vehicle Management Area would have the greatest increase in ground disturbance. Watershed conditions would be worse compared to alternative 2, with cascading impacts on riparian function, thereby negatively affecting southwestern willow flycatcher, western yellow-billed cuckoo, and New Mexico meadow jumping mouse.

Mexican spotted owl

Determination: Based on the analysis of plan components and the amount of habitat provided for nesting and roosting, there could be some localized adverse impacts to the owl and its critical habitat, but overall, Mexican spotted owl species viability would be maintained. Beneficial impacts include a slight to moderate improvement in potentially suitable habitat in dry mixed conifer and ponderosa pine systems by increasing the amount of habitat in the desired seral states for breeding and foraging.

Canada lynx

Determination: While some individuals could be impacted by actions on the forest, the alternative management activities would not adversely affect the viability of the species. Overall, Canada lynx species viability would be maintained.

Southwestern willow flycatcher, western yellow-billed cuckoo, and New Mexico meadow jumping mouse

Determination: Based on the analysis of plan components and the amount of habitat provided for each of the above species, viability would be maintained for each of these species dependent on riparian and aquatic habitat under alternative 3. Beneficial impacts include a slight improvement in potentially suitable habitat in riparian and aquatic systems.

Environmental Consequences for Federally Listed Species – Alternative 4

The primary difference between alternative 4 and the other alternatives is the greater use of naturally-ignited wildfires and prescribed fires to achieve restoration objectives (125,000 to 225,000 acres during each 10-year period) under alternative 4. Mechanical treatment would focus on treating fuels to protect communities instead of forestwide restoration. Alternative 4 also includes four place-based management areas, which would have their own plan components. Proposed management areas included under alternative 4 are Wetland Jewels Management Area (forestwide), Valle Vidal Management Area (Questa Ranger District), San Antonio Management Area (Tres Piedras Ranger District), and Rio Grande Cutthroat Trout Management Area (forestwide). Otherwise, forestwide plan components would be the same as described previously under Environmental Consequences for All Action Alternatives. Under alternative 4, unplanned ignitions would be encouraged to play their natural role in ecosystems at the landscape level more than other alternatives. Current understanding of fire and its use has evolved over the last 50 years and the scientific community now recognizes the beneficial effects lower-intensity wildfire may have on forest structure and wildlife ecological condition (C. Miller and Aplet 2016). A caveat to this would be high-intensity, landscape-scale fires that would be detrimental to wildlife species that use frequent fire-adapted systems.

Mexican spotted owl

After 15 years, desired conditions for mixed conifer with frequent fire would remain moderately departed but would move closer to the desired state, changing from a departure of 64 percent to 44 percent. For Mexican spotted owl, this alternative would be similar to alternative 2 in terms of overall ecological condition improved for these two vegetation types. However, the decrease of mechanical treatment could also put Mexican spotted owl at greater risk for reductions of foraging, nesting, and roosting habitat resulting from uncharacteristic, stand-replacing wildfire. Based on Vegetation Dynamics Development Tool modeling for alternative 4, it is estimated that the amount of frequent fire forest available for nesting and roosting would increase in 15 years from 16 percent to 33 percent (41,439 acres to 86,175 acres). This is more than alternative 1, but less than alternatives 2, 3, and 5 (see table 40 for all results by alternative).

Southwestern willow flycatcher, western yellow-billed cuckoo, and New Mexico meadow jumping mouse

Wetland Jewels Management Area would focus road obliteration and riparian restoration work in these areas rather than in priority watersheds, which is where riparian restoration activities are focused in all other action alternatives. The efficacy or feasibility of treating these areas is not clearly greater than they are for treating other locations on the forest. In fact, treatment return on investment is likely to be low, since 49 percent of the Wetland Jewels Management Area is in either designated wilderness, recommended wilderness, or inventoried roadless areas, each of which restricts management options compared to other forest areas. For example, earth work or moving boulders by hand is more costly, time consuming, and labor intensive than doing the same work with machinery. Wetland Jewels Management Area should benefit southwestern willow flycatcher, western yellow-billed cuckoo, and New Mexico meadow jumping mouse within this management area, but emphasis on aquatic and riparian restoration within this management area would improve forestwide ecological conditions for riparian and aquatic vegetation communities at a slower rate and intensity than other action alternatives.

Rio Grande Cutthroat Trout Management Area would focus native aquatic species restoration work in these areas. Treatments to remove nonnative species (MA-RGCTMA-O 1) and desired condition that improves connectivity and ecological condition within the Rio Grande Cutthroat Trout Management Area (MA-RGCTMA-DC 1) would increase native aquatic species distribution, but would have no effect on southwestern willow flycatcher, western yellow-billed cuckoo, or New Mexico meadow jumping mouse.

Canada lynx

Conditions and trends in high-elevation forest did not raise significant concerns, therefore, no objectives were developed for them. The Carson has, however, identified desired conditions for high-elevation forest, and would implement management to make progress toward desired conditions as capacity allows. The amount of high-elevation forest is not expected to change under any alternative. Plan components discussed under all action alternatives would help to offset any potentially adverse effects to high-elevation ecological condition needed for Canada lynx. This alternative would improve habitat connectivity for this species through the reduction of roads, decrease human intrusive disturbance, and decrease snow compaction ([All Listed Species](#)).

All Listed Species

Alternative 4 limits motorized access through several means, including stricter guidance regarding the creation of new permanent or temporary roads (FW-TFA-S 3-4), obliterating or naturalizing double the number of miles of non-system roads (FW-TFA-O 1), expanding the San Antonio Management Area and requiring seasonal closures (MA-SAMA-S 8-9), prohibiting new motorized trails within Valle Vidal and San Antonio Management Areas (MA-VVMA-S-24, MA-SAMA-S-12), and prohibiting new permanent roads or motorized trails in the Wetland Jewels Management Area (MA-WJMA-S-1). Riparian impacts such as sedimentation and vegetation removal would be slightly reduced overall. Invasive species spread would be slowed somewhat related to reduced access by motorized vectors, but treatment to restore riparian function

may also be made more difficult in some locations. Decreases in ground disturbance, intrusive human activity, sedimentation, and distribution of invasive species would beneficially impact federally listed species.

Valle Vidal and San Antonio Management Areas would have similar effects as discussed for alternatives 2 and 5, with the exception of the above discussion on limiting motorized access. Grassland Maintenance Management Area is not proposed under this alternative.

This alternative would also have the highest negative impact from uncharacteristic stand-replacing wildfire.

Mexican spotted owl, Canada lynx, southwestern willow flycatcher, New Mexico meadow jumping mouse

Determination: Based on the analysis of plan components and the amount of habitat provided for each of the above species, viability would be maintained for all federally listed species under alternative 4.

Summary of All Alternatives for Federally Listed Species

All alternatives would maintain viability for federally listed species (within the authority of the Forest Service); however, the rate and magnitude of change to wildlife ecological condition varies by alternative.

Alternative 1 is limited in terms of its ability to positively affect viability for federally listed species, because it lacks clear desired conditions and guidelines developed using the best available science. It does not reflect the most current advances in scientific understanding and changes in social, economic, and ecological conditions that have occurred since it was signed, and it is the least able to adapt to changing conditions. Alternative 1 also lacks forestwide language that directly addresses the significant threats of disease and invasive, nonnative animals; connectivity; altered hydrology; and restricted and endemic species that are naturally rare. Plan components for at-risk species were not developed using the coarse-filter/fine-filter process. Overall, this alternative would realize the least amount of restoration progress for the most wildlife species compared to action alternatives. At best, viability for federally listed species would be maintained, but ecosystem recovery would be on a slower trajectory than for the action alternatives.

Alternative 3 focuses on forest products and increased human use. This alternative has more clearly defined plan components than alternative 1 to better address wildlife species needs at multiple spatial scales. Under this alternative species are generally protected through specific vegetation community, watershed, and management area direction, however, in some cases there is additional species-specific direction that provides even more emphasis and protection for at-risk species. Alternative 3 was specifically developed using a coarse-fine filter process. Alternative 3 has the greatest ability for maintaining species persistence over time (for the majority of species). This alternative, with increased mechanical treatment, would move departed ecological condition of frequent fire forest toward desired condition the fastest and make more progress for improving nest/roost habitat for Mexican spotted owl. However, increased mechanical treatment, potential to increase road use, and inclusion of the Off-Highway Vehicle Management Area would have the greatest increase in ground disturbance. Watershed conditions would be worse compared to alternative 2, with cascading impacts on riparian function, thereby negatively impacting Canada lynx, southwestern willow flycatcher, western yellow-billed cuckoo, and New Mexico meadow jumping mouse.

Alternatives 2 and 4 would move ecological condition toward the desired conditions faster than alternative 1. However, alternative 4 would move riparian and aquatic ecological conditions toward the desired condition at a slower rate than alternatives 2 or 3, because restoration overall would be slightly less effective. Alternative 4 would also have the highest negative impact from uncharacteristic, stand-replacing wildfire. Both alternatives would include the same forestwide plan components for federally listed species as alternative 3.

Alternatives 4 and 5 recommend more new wilderness than alternatives 2 and 3, which would benefit federally listed species in the short term. However, the forest would be limited to naturally ignited wildfires

managed for resource benefit in these areas. As a result, the net positive impacts from these additions on wildlife would be counterbalanced by the potentially negative effects that could result from large, stand-replacing wildfire.

Table 40. Estimated change in potential nesting and roosting habitat in frequent fire forest for Mexican spotted owl by alternative

Species	Current acres	Alternative 1 acres	Alternative 2 acres	Alternative 3 acres	Alternative 4 acres	Alternative 5 acres
Mexican spotted owl	41,212	65,405	87,347	91,004	86,175	87,347

Species of Conservation Concern

A species of conservation concern is defined by the 2012 Planning Rule as “a species, other than federally recognized threatened, endangered, proposed, or candidate species, that is known to occur in the plan area and for which the regional forester has determined that the best available scientific information indicates substantial concern about the species’ capability to persist over the long-term in the plan area.” For many species, essential ecological conditions may be provided for through “coarse filter” plan components such as desired conditions, standards, and guidelines for specific vegetation types. These may be adequate to ensure persistence of those species and maintain viable populations within the Plan area. For other species, “fine-filter” plan components that are species-specific (timing restrictions, etc.) may be required to ensure persistence. Table 41 identifies potential Carson species of conservation concern, their associated vegetation system, and rationale for species of conservation concern consideration.

Species of Conservation Concern Status, Key Ecological Conditions, and Threats

Northern leopard frog

Northern leopard frogs (*Lithobates pipiens*) are generally associated with slow-moving, permanent, or semi-permanent bodies of water (Christman 2010; Merrell 1970; Smith and Keinath 2007). However, this species is also dependent upon a multitude of ecological conditions and habitat connectivity to meet the requirements for all life stages, including wet, upland habitats during the summer (Christman 2010; Merrell 1970; Smith and Keinath 2007). This species is associated with montane and subalpine grasslands, riparian vegetation communities, and aquatic ecosystems. Primary threats include disease (e.g., chytridiomycosis), invasive species competition, and depredation by bull frogs (Finch 1992; NMDGF 2006a; Smith and Keinath 2007). Threats from management actions such as livestock grazing, road management, and recreation also include degradation of riparian habitat through departure of herbaceous understory vegetation by the loss of vegetation diversity, increased sedimentation, and reduction in in-stream flow. Beneficial management includes the development of stock ponds, as northern leopard frogs use these sites for breeding ponds.

Western boreal toad

Western boreal toad (*Anaxyrus boreas*) within the Carson, is only confirmed at Lagunitas, Canjilon, and Trout Lakes (NMDGF 2006a). Boreal toads are prolific breeders and are highly mobile. They breed in a wide variety of aquatic habitats, ranging from low-elevation beaver ponds, reservoirs, streams, marshes, lakeshores, potholes, wet meadows, and ditches to high-elevation ponds, fens, and tarns (high mountain lakes) at or near treeline (Livo and Lambert 2001; NMDGF 2006a). This species is associated with riparian vegetation communities and aquatic ecosystems. Primary threats include disease (e.g., chytridiomycosis), invasive species competition, and depredation by bull frogs (NMDGF 2006a; Smith and Keinath 2007). Threats from management actions such as livestock grazing, road management, and recreation also include degradation of riparian habitat through departure of herbaceous understory vegetation by the loss of vegetation diversity, increased sedimentation, and reduction in in-stream flow.

Table 41. Potential species of conservation concern, habitat, and rationale

Species	Habitat	Rationale for at-risk for persistence on the Carson
Northern leopard frog <i>Lithobates pipiens</i>	slow-moving, permanent, or semi-permanent bodies of water and wet meadows	Limited range and highly departed ecological condition
Western boreal toad <i>Bufo boreas</i>	beaver ponds, reservoirs, streams, marshes, lakeshores, potholes, wet meadows, ditches, ponds, fens, and high mountain lakes at or near treeline	Limited distribution on the Forest, small population number, and highly departed ecological condition
American peregrine falcon <i>Falco peregrinus anatum</i>	nests in cliffs and rock outcrops	Limited numbers and stagnant reproduction
Northern goshawk <i>Accipiter gentilis</i>	mixed conifer with aspen, mixed conifer frequent fire, ponderosa pine, and aquatic ecosystems	Highly departed ecological condition, threat of large stand-replacing fires
Pinyon Jay <i>Gymnorhinus cyanocephalus</i>	piñon-juniper woodland and piñon-juniper sagebrush	Downward population trends
Western burrowing owl <i>Athene cunicularia</i>	montane subalpine grassland, and sagebrush	Loss of prairie dog population, downward population trend, and susceptibility to plague
White-tailed ptarmigan <i>Lagopus leucura</i>	alpine and tundra, near snowfields, streams, and willow-dominated	Limited geographic range, isolated population, and limited numbers
Wilson's warbler <i>Cardellina pusilla</i>	riparian consisting of willow, bog birch, and shrubby cinquefoil	Highly departed ecological condition, downward population trend, and limited range in NM
Rio Grande chub <i>Gila pandora</i>	riverine and lake habitats	Decline in range and abundance, and highly departed ecological conditions
Rio Grande cutthroat trout <i>Onchorhynchus clarkii virginalis</i>	montane streams	Isolated population and highly departed ecological conditions
Rio Grande sucker <i>Catostomus plebeius</i>	low-gradient, low-velocity stream reaches	Decline in range and abundance, and highly departed ecological conditions
Nokomis fritillary butterfly <i>Speyeria nokomis nokomis</i>	streamside meadows and bogs within arid ponderosa pine, piñon-juniper woodland, and sagebrush ecosystems	Restricted distribution, low numbers, highly departed ecological conditions
Gunnison's prairie dog <i>Cynomys gunnisoni</i>	meadow and grassland habitats where fine soil material is deep enough to allow for construction of burrows	Decreased range on the forest, their isolated populations, and susceptibility to plague.
Masked shrew <i>Sorex cinereus</i>	banks of cold streams, in wet meadows, and under logs within Spruce-Fir and Bristlecone Pine Forest	Highly departed ecological condition and downward population trend
Pale Townsend's big-eared bat <i>Corynorhinus townsendii pallescens</i>	hibernate and roost in caves and abandoned mine features	Downward population trend and limited roosting habitat
Spotted bat <i>Euderma maculatum</i>	ideal roost sites are cliffs, rocky outcrops, or caves that are near water (streams, pond, and tanks) and open areas for foraging of insects within Mixed Conifer-Frequent Fire and Ponderosa Pine vegetation communities	Highly departed ecological condition, low population numbers, threat of large stand-replacing fires

Species	Habitat	Rationale for at-risk for persistence on the Carson
Water shrew <i>Sorex palustris</i>	riparian habitats in the vicinity of permanent streams above 8,000 feet in elevation	Highly departed ecological condition and downward population trend
Alpine larkspur <i>Delphinium alpestre</i>	rocky outcrops of the Alpine Tundra	Isolated population, limited distribution, low numbers
Arizona willow <i>Salix arizonica</i>	High-elevation riparian areas	Isolated population, limited distribution, low numbers
Chaco milkvetch <i>Astragalus micromerius</i>	Todilto gypsum or limy sandstone in Piñon-Juniper Woodlands	Isolated population, limited distribution, low numbers
Chama blazing star <i>Mentzelia conspicua</i>	gray to red shales of Mancos and Chinle soil formations in the Piñon-Juniper Woodland	Isolated population, limited distribution, low numbers
Pagosa milk-vetch <i>Astragalus missouriensis</i> var. <i>humistratus</i>	Mancos and Lewis soil formations within Ponderosa Pine Forest and Piñon-Juniper Woodland	Isolated population, limited distribution, low numbers
Ripley's milkvetch <i>Astragalus ripleyi</i>	volcanic substrates within Ponderosa Pine Forest and Piñon-Juniper Woodland	Isolated population, limited distribution, low numbers
Robust larkspur <i>Delphinium robustum</i>	valley bottoms, riparian woodlands, subalpine meadows, and aspen groves in montane coniferous forests from 7,000 to 11,200 feet elevation.	Isolated population, limited distribution, low numbers
Small-headed goldenweed <i>Ericameria microcephala</i>	granite rock crevices and outcrops within Ponderosa Pine Forest	Isolated population, limited distribution, low numbers
Tufted sand verbena <i>Abronia bigelovii</i>	Todilto gypsum or limy sandstone in Piñon-Juniper Woodlands	Isolated population, limited distribution, low numbers

American peregrine falcon

Peregrine falcons (*Falco peregrinus anatum*) are breeding or permanent residents within the Carson. This species nests in cliffs and rock outcrops, a key ecosystem characteristic found within all vegetation communities of the Carson. Adult falcons demonstrate a high degree of breeding fidelity and are known to reuse the same cliff nest site for several decades (USDI FWS 2003). Nesting habitat is created by geologic factors and has not changed significantly. Threats include disturbance from recreational rock climbing (Poole 2018), collection of young for falconry, and illegal shooting. Disturbance near active nests can displace individuals and cause nest abandonment (Poole 2018) when reasonable precautions aren't taken. Many of the activities that may be threats to peregrine falcons are not under the authority of the Forest Service or occur on other land ownerships.

Northern goshawk

The northern goshawk (*Accipiter gentilis*) is a forest habitat generalist that uses a wide variety of forest ages, structural conditions and successional stages, most of which are departed from reference because of fire suppression activities and, in some cases, stand-replacing fire (Reynolds et al. 1992). This species can be found within every district of the Carson, where post-fledging family areas are identified and managed. Several of these post-fledging family areas have been abandoned for unknown reasons, but several new post-fledging family areas have been established on the Carson (Cortez 2018). This species is primarily associated with mixed conifer with aspen, mixed conifer frequent fire, and ponderosa pine vegetation communities and aquatic ecosystems. Recent work by Reynolds et al. (2017), suggests climate change-related effects have the potential to negatively affect goshawk productivity. They concluded that key threats are climate change-related drought effects on prey abundance coupled with departure in seral state conditions from loss of dense High Elevation and Frequent Fire Forest, changes in fire regime, and from stand-replacing fire. This study reinforces previous work by Salafsky et al. (2005) who found that while goshawks readily exploited a variety

of different prey species, their overall productivity was greatly driven by differences in the densities of several key prey species.

Pinyon jay

Pinyon jay (*Gymnorhinus cyanocephalus*) are primarily piñon-juniper woodland obligates but will use other habitat if piñon-juniper woodland does not exist (Wiggins 2005). They are found throughout piñon-juniper woodlands of the Carson. Pinyon jay are synchronized, colonial nesters that commence breeding in the cold of winter in areas where pine-seed crops were abundant the previous autumn (Poole 2018). Currently, the primary threats to pinyon jay population viability is a widespread die-off of piñon pine in the southwestern United States, together with departure in seral state conditions from loss of dense and old-growth piñon-juniper woodlands, changes in fire regime, and from stand-replacing fire (Wiggins 2005).

Western burrowing owl

Burrowing owls (*Athene cunicularia hypugaea*) are known to use all lower elevation grassland ecological conditions of the Carson. They nest and roost in recently abandoned burrows dug by mammals, including ground squirrels, prairie dogs, and badgers (Green and Anthony 1989). For this reason, viability of burrowing owls is inextricably linked to that of burrowing mammals, including prairie dogs. Threats to this species on the Carson include threats to burrowing mammals, such as Gunnison's prairie dogs, from sylvatic plague (Finch 1992).

White-tailed ptarmigan

White-tailed ptarmigan (*Lagopus leucura*) inhabits moist vegetation near snowfields, streams, and willow-dominated (*Salix* spp.) plant communities within alpine and tundra habitat. Buds and twigs of various species of *Salix* provide the bulk of the food eaten by white-tailed ptarmigan. Rocky areas near late-lying snowfields or other moist sites become important from mid-summer to early fall. Rocks provide protection from the weather and hiding cover from avian predators (Hoffman 2006). In winter, according to work by Choate (1963), ptarmigan occupy rocky areas and patches of krummholz. According to Wolfe and others (2012), an estimated 100 to 200 individual white-tailed ptarmigans are found within the alpine and tundra habitat of the Carson. Major threats from management actions such as livestock grazing and recreation include departure of herbaceous understory vegetation through loss of willow and willow recruitment and disturbance during breeding (NMDGF 2017).

Wilson's warbler

Wilson's warbler (*Cardellina pusilla*) inhabit Rocky Mountain mesic shrub thickets consisting of willow, bog birch, and shrubby cinquefoil (Poole 2018). The Carson is the most southern distribution for this species (NMPIF 2018). They are associated with forest and shrub riparian vegetation community. Threats from management actions such as livestock grazing, recreation, and roads include degradation of riparian habitat through the loss willow density and recruitment, reduction of in-stream flow, and invasive species encroachment (Johnson and Anderson 2003).

Rio Grande chub

The Rio Grande chub (*Gila pandora*) inhabits both riverine and lake habitats (Calamusso and Rinne 1999; Rees et al. 2005) and prefers cobble, gravel, sand, and silt as common substrate types (Rees et al. 2005). This species is usually found in pools with overhanging banks or vegetation (Calamusso and Rinne 1996; Rinne 1995a). The Rio Grande chub spawns in spring and early summer (Calamusso and Rinne 1996; Rees et al. 2005). Young chubs can be found in beds of aquatic macrophytes (i.e., *Nasturtium officinale*) and utilizing the cover provided by overhanging banks (Rees et al 2005). As of 2014, Rio Grande chub were found in isolated locations of the Carson, and the species is under review for Federal listing. Populations in New Mexico are considered stable, but this species has substantially declined from historic levels (Rees et al. 2005). Threats to this species include hybridization and food competition with nonnative species. Threats

from changes in ecological condition from management actions such as livestock grazing, recreation, and roads include reduction of in-stream flow, increased sedimentation levels, loss of riparian coarse woody debris, population fragmentation due to stream dewatering, and increased temperature from the loss of overhanging banks and woody and herbaceous riparian vegetation (Rees et al. 2005).

Rio Grande cutthroat

Rio Grande cutthroat trout (*Oncorhynchus clarkii virginalis*) are found in montane streams in habitats similar to other trout species (Pritchard and Cowley 2006). Rio Grande cutthroat trout rely on a variety of ecological conditions depending on stage within the life cycle. Well-oxygenated, gravelly areas are needed for egg development; slow-moving, shallow areas are needed for fry; and adult fish prefer higher velocity waters and pools in the main stream area (Pritchard and Cowley 2006). This species spawns from March to July, depending on stream flow and water temperature (Rinne 1995c; Sublette et al. 1990). Populations of this species are currently restricted to just 19 to 34 percent of their historic range within Carson (USDA FS Carson NF 2015a). Threats to this species include hybridization, food competition with nonnative species, and whirling disease (Pritchard and Cowley 2006). Threats from changes in ecological condition from management actions such as livestock grazing, recreation, and roads include reduction of in-stream flow, increased sedimentation levels, loss of riparian coarse woody debris, population fragmentation due to stream dewatering, and increased temperature from the loss of overhanging banks and woody and herbaceous riparian vegetation (Rees et al. 2005). Efforts within Carson headwaters have been underway since 2000 to chemically remove hybrids and construct barriers in order to protect and restore Rio Grande cutthroat trout genetic integrity and to protect this important stronghold within the headwaters of the Rio Grande watershed (Alves et al. 2008).

Rio Grande sucker

The Rio Grande sucker (*Catostomus plebeius*) prefer low-gradient, low-velocity stream reaches (Calamusso et al. 2002). Preferred ecological conditions include rocky pools, runs, riffles, backwaters, and beaver ponds (Calamusso and Rinne 1996). Spawning is variable and is based on water temperature, stream size, and the pattern of seasonal runoff (Rinne 1995b) and usually occurs in the spring, although a second spawning in fall has been suggested, although not documented (Calamusso and Rinne 1996; Rinne 1995b). On the Carson, Rio Grande suckers were rarely collected above 9,000 feet and were associated with cooler water temperatures (Rees et al. 2005). According to Calamusso et al. (2002), this species appears to be declining in its northern range of New Mexico. Threats to this species include hybridization and food competition with nonnative species. Threats from changes in ecological condition from management actions such as livestock grazing, recreation, and roads include reduction of in-stream flow, increased sedimentation levels, loss of riparian coarse woody debris, population fragmentation due to stream dewatering, and increased temperature from the loss of overhanging banks and woody and herbaceous riparian vegetation (Rees et al. 2005).

Nokomis fritillary butterfly

Nokomis fritillary butterfly (*Speyeria nokomis nokomis*) inhabits streamside meadows and bogs within arid ponderosa pine, piñon-juniper woodland, and sagebrush ecosystems (Selby 2007). The presence of bog violet is a critical ecological component, as this is the primary larval food plant (Selby 2007). Microhabitat conditions for the bog violet is wet alkaline soils and shade, often under willows (Selby 2007). It is also important to have plenty of nectar sources such as thistles, horsemint (*Agastache spp.*), and Joe pye weed (*Eupatorium maculatum*) nearby (NatureServe 2018). This species distribution within the Carson is limited, as wetland habitat found in arid ecosystems are rare, small, and isolated (Cary and Holland 1992). This species is primarily associated with wetland riparian vegetation community. Threats from management actions such as livestock grazing and recreation include loss of bog violet component, loss of nectar sources, and loss of microhabitat condition from decreased groundwater retention and increased soil compaction.

Gunnison's prairie dog

The Gunnison's prairie dogs (*Cynomys gunnisoni*) on the Carson are associated with meadow and grassland habitats where fine soil material is deep enough to allow for construction of burrows. Despite the extensive grasslands on Carson, prairie dogs were uncommon (Frey 2003). Threats include recreational shooting (Finch 1992; USDA FS 2013b) and sylvatic plague (Finch 1992; Rocke et al. 2015). Sylvatic plague could be affected by management because the Carson could elect to "dust" prairie dog burrows with the insecticide Deltamethrin, which controls fleas infected with the plague bacterium.

Masked shrew

Masked shrew (*Sorex cinereus*) are found throughout the Carson. This species hunts insects and other small mammals along banks of cold streams, in wet meadows, and under logs within spruce-fir and bristlecone pine forest (Frey and Yates 1996). Ecological condition is associated with moist sites with deep enough soil or duff to burrow (Whitaker 2004). Threats to this species include climate change, as it prefers wet areas in upper elevations that may be altered due to rising temperatures (BISON-M 2020). Threats also include loss of ecological condition from fuelwood gathering, grazing, wildfire, recreation, and roads.

Pale Townsend's big-eared bat

The Townsend's big-eared bat (*Corynorhinus townsendii pallescens*) has not been documented on the Carson since 1998. They hibernate and roost in caves and abandoned mine features, which are rare on the Carson. Ongoing activities known to impact habitats used by the bats include recreational caving or mine exploring, vandalism, renewed mining (Finch 1992; Gruver and Keinath 2006; Schmidt 2003; WBWG 2005), and potentially white-nose syndrome, a lethal fungal infection in some species of hibernating bats in the eastern and midwestern U.S. (Cryan et al. 2013). Past activities, such as improper cave and mine closures, have led to a reduction in the number of available hibernacula for this species.

Spotted bat

Spotted bat (*Euderma maculatum*) has been recorded in diverse habitats up to 10,000 feet elevation (BISON-M 2020; NatureServe 2020). This species is more dependent on roost availability and water than on vegetation types. The ideal roost sites for this species are cliffs, rocky outcrops, or caves that are near water (streams, pond, and tanks) and open areas for foraging insects within mixed conifer-frequent fire and ponderosa pine vegetation communities. In New Mexico, this bat has been found in about 20 locations (NMDGF 2008), including on the Carson (Gannon et al. 1998; Geluso 2006). According to Luce (2007), spotted bats probably occur in highly localized sub-populations where suitable ecological conditions exist. Ongoing activities known to impact ecological conditions used by the bats include recreational mine adit exploring, recreational rock climbing, vandalism, renewed mining (Finch 1992; Luce and Keinath 2007; WBWG 2005), and potentially white-nose syndrome, a lethal fungal infection in some species of hibernating bats in the eastern and midwestern U.S. (Cryan et al. 2013). Past activities, such as improper mine closures, have led to a reduction in the number of available hibernacula for this species.

Water shrew

Water shrew (*Sorex palustris*) are strongly associated with riparian habitats in the vicinity of permanent streams above 8,000 feet in elevation (BISON-M 2020; Conaway 1952; Frey and Yates 1996). This species typically utilizes areas with abundant cover, such as rocks, logs, or overhanging streambank vegetation (Conaway 1952; NatureServe 2020) and will create burrows within these ecological conditions. High elevation forest riparian habitats on the Carson are limited (less than 3 percent of the forest). Threats from changes in ecological condition by management actions such as livestock grazing and roads include reduction of in-stream flow, increased sedimentation levels, loss of riparian coarse woody debris, loss of overhanging banks, and loss of woody and herbaceous riparian vegetation (BISON-M 2020).

Alpine larkspur

Alpine larkspur (*Delphinium alpestre*) are found within the rocky outcrops of the alpine tundra (NMRPTC 2020). Within New Mexico, populations of alpine larkspur are restricted to the alpine tundra of the Carson NF, and therefore, have limited distribution. The remote and relatively inaccessible habitats of this species provide it with a large degree of protection from land use impacts, however, this species can be targeted for weed control and seed collection (NMRPTC 2020).

Arizona willow

Arizona willow (*Salix arizonica*) is only found in high-elevation riparian areas (montane subalpine grassland and forest and shrub riparian vegetation communities). Thirteen populations occupy approximately 50 acres in the Cabresto Creek, Sawmill Creek, and Bitter Creek headwaters, and Lagunitas Creek on the Questa, Tres Piedras, and Camino Real Ranger Districts of the Carson (AWITT 1995). Threats to Arizona willow from management actions such as livestock grazing and recreational snowmobiling include decrease in groundwater retention, increase in soil compaction, invasive species encroachment, and direct harm to the plant itself (AWITT 1995).

Chaco milkvetch

Chaco milkvetch (*Astragalus micromerius*) is restricted to Todilto gypsum or limy sandstone in piñon-juniper woodlands on the Canjilon Ranger District (NMRPTC 2020). Threats include loss of Todilto gypsum or limy sandstone through disturbance or direct harm to the plant itself. Due to its dependence on sandstone that is blended with Todilto gypsum or limestone, populations of this plant are small and isolated on the Carson (NMRPTC 2020).

Chama blazing star

Chama blazing star (*Mentzelia conspicua*) is only found on the Carson in small and isolated populations on the Canjilon Ranger District. It is restricted to gray to red shales of Mancos and Chinle soil formations in the piñon-juniper woodland (NMRPTC 2020). Threats include invasive species encroachment (NMRPTC 2020).

Pagosa milkvetch

Pagosa milkvetch (*Astragalus missouriensis* var. *humistratus*) is only found on the Carson in one small and isolated population on the Jicarilla Ranger District (NMRPTC 2020). It is restricted to Mancos and Lewis soil formations within ponderosa pine forest and piñon-juniper woodland vegetation communities (Decker 2006). Threats include loss of Mancos and Lewis soil or direct harm to the plant itself (Decker 2006).

Ripley's milkvetch

Ripley's milkvetch (*Astragalus ripleyii*) on the Carson is exclusively associated with volcanic substrates within ponderosa pine forest and piñon-juniper woodland vegetation communities on the Tres Piedras, Questa, and Camino Real Ranger Districts (Ladyman 2003). Currently, it has been identified at 44 locations in New Mexico, of which 10 are on the Carson (Ladyman 2003). This is one of the few New Mexico milkvetches that is a desirable forage plant. It is relished by deer, elk, and all classes of livestock, without toxic effects common to other *Astragalus* species (NMRPTC 2020). This species is vulnerable to invasive species encroachment and direct harm to the plant itself.

Robust larkspur

Robust larkspur (*Delphinium robustum*) occurs in valley bottoms, riparian woodlands, subalpine meadows, and aspen groves in lower and upper montane coniferous forests of the Carson from 7,000 to 11,200 feet (spruce-fir forest and mixed conifer with aspen vegetation communities). Six occurrences have been reported in New Mexico, three of which were found on the Carson (SEINet 2020). This species is occasionally

targeted for weed control, as some species of larkspur are poisonous to livestock. Additional threats include direct harm to the species itself.

Small-headed goldenweed

Small-headed goldenweed (*Ericameria microcephala*) is restricted to granite rock crevices and outcrops within ponderosa pine forest (NMRPTC 2020). Small-headed goldenweed is abundant on the Tres Piedras Ranger District of the Carson. Threats include loss of granite rock crevices or direct harm to the plant itself (NMRPTC 2020).

Tufted sand verbena

Tufted sand verbena (*Abronia bigelovii*) on the Carson is restricted to Todilto gypsum or limy sandstone in piñon-juniper woodlands on the Canjilon Ranger District (NMRPTC 2020). Threats include loss of Todilto gypsum or limy sandstone or direct harm to the plant itself. Due to its dependence on sandstone that is blended with Todilto gypsum or limestone, populations of this plant are isolated on the Carson (NMRPTC 2020).

Each species of conservation concern is associated with one or more vegetation communities. Vegetation communities are where the species is known to spend all, or most of its life, or it can be a special ecological feature within a vegetation community that provides habitat for a critical life cycle need. Identifying degraded ecological conditions allows forest staff to best direct their management actions to maintain or improve conditions for species of conservation concern. Table 42 shows vegetation communities and associated species of conservation concern.

Table 42. Vegetation systems, vegetation community within the vegetation systems, and associated species of conservation concern

Vegetation System	Vegetation Community Name	Associated Species of Conservation Concern
Non-forested	Alpine tundra, montane and subalpine grasslands, sagebrush	American peregrine falcon, white-tailed ptarmigan, alpine larkspur, western burrowing owl, Gunnison's prairie dog, masked shrew, spotted bat, Ripley's milkvetch, tufted sand verbena
High Elevation Forest	Bristlecone pine, spruce-fir forest, mixed conifer with aspen	American peregrine falcon, northern goshawk, masked shrew, pale Townsend's big-eared bat, robust larkspur
Frequent Fire Forest	Mixed conifer with frequent fire, ponderosa pine	American peregrine falcon, northern goshawk, pale Townsend's big-eared bat, spotted bat, Pagosa milkvetch, Ripley's milkvetch, robust larkspur, small-headed goldenweed
Woodlands	Piñon-juniper woodland, piñon-juniper sagebrush	American peregrine falcon, pinyon jay, pale Townsend's big-eared bat, spotted bat, Chaco milkvetch, Chama blazing star, Pagosa milkvetch, Ripley's milkvetch, tufted sand verbena
Riparian	Wetland riparian, forest and shrub riparian	Northern leopard frog, western boreal toad, American peregrine falcon, Wilson's warbler, Nokomis fritillary butterfly, masked shrew, spotted bat, water shrew, Arizona willow, robust larkspur
Aquatic	Watershed and water, steams, waterbodies, springs and seeps	Northern leopard frog, western boreal toad, Rio Grande chub, Rio Grande cutthroat trout, Rio Grande sucker
Cave-like structures and Rocky Features	Cliffs, rocky outcrops, talus slopes, mine adit, cave like structures (caves and abandoned mines and cliffs and rocky features)	American peregrine falcon, pale's Townsend big-eared bat, spotted bat, alpine larkspur, Chaco milkvetch, Chama blazing star, small-headed goldenweed, tufted sand verbena

Environmental Consequences for Species of Conservation Concern

Environmental Consequences for Species of Conservation Concern Common to All Alternatives

Effects of probable management activities that could potentially affect wildlife communities can be grouped into three broad categories: (1) changes in the type, quantity, quality, and spatial arrangement of suitable ecological conditions; (2) direct mortality, reduced survival, or increased susceptibility to mortality; and, (3) increased disturbance.

For each species or group of species, the plan considers the extent that ecosystem-level plan components provide for ecosystem integrity and diversity to meet the ecological conditions necessary for those species within their range. Species-specific plan components were added as needed. Appendix H lists the forest wide plan components that would apply to species of conservation concern wildlife, plant, and aquatic species under all action alternatives. The action alternatives have additional place-based plan components or objectives that are described in their individual sections. The following analysis applies to shared plan components.

Ecological Condition

All five alternatives would use mechanical vegetation treatment and wildfire to manage frequent fire forest (e.g., dry mixed conifer and ponderosa pine) and mechanical vegetation treatment or structural improvement to manage riparian/water resources (e.g., aquatics, forested riparian) to improve ecological condition, abundance, and distribution for species that depend on those vegetation communities. These systems are all highly departed from reference conditions. Current science demonstrates the positive benefits that forest fuel-reduction treatments can have in terms of improving resiliency in frequent fire-adapted systems of the west/southwest (Stephens et al. 2018). Conditions and trends in the other vegetation communities did not raise significant concerns, therefore no objectives were developed for them. The Carson has, however, identified desired conditions for these other vegetation communities and would implement management to make progress toward desired conditions as capacity allows.

For species that use frequent fire forests (dry mixed conifer and ponderosa pine), riparian (wetlands and forested riparian), and aquatic systems, like the American peregrine falcon, northern goshawk, pale Townsend's big-eared bat, spotted bat, northern leopard frog, western boreal toad, masked shrew, water shrew, Arizona willow, Rio Grande chub, Rio Grande cutthroat trout, and Rio Grande sucker, the primary contemporary threat is loss of habitat related to large stand-replacing wildfire, associated runoff and sedimentation that could affect riparian habitat, and reduced in-stream flow. All alternatives would move ecological condition for these species toward the desired state through desired condition and objectives, but would vary in magnitude, intensity, and location of treatments based on objectives. Impacts to these species from different objectives will be discussed by alternatives.

Objectives by Alternative:

- Alternative 1: no objectives
- Alternative 2: Mixed conifer with frequent fire: Mechanically treat at least 5,500 to 10,000 acres, during each 10-year period following plan approval, and during each 10-year period following plan approval, treat at least 20,000 to 40,000 acres using a combination of prescribed fire and naturally ignited wildfire to make progress toward or to maintain desired conditions.
 - ◆ Ponderosa pine forest: Mechanically treat at least 22,000 to 50,000 acres, during each 10-year period following plan approval, and during the 10 years following plan approval, treat at least 80,000 to 125,000 acres using a combination of prescribed fire and naturally ignited wildfire to make progress toward or maintain desired conditions.
 - ◆ Riparian: Restore structure and function of at least 200 to 300 acres of nonfunctioning and functioning-at-risk riparian areas annually. Treatments align with priority watersheds.

- Alternative 3: Mixed conifer with frequent fire: Mechanically treat at least 15,000 to 30,000 acres, during each 10-year period following plan approval.
 - ◆ Ponderosa pine forest: Mechanically treat at least 50,000 to 100,000 acres, during each 10-year period following plan approval.
 - ◆ Riparian: Restore structure and function of at least 200 to 300 acres of nonfunctioning and functioning-at-risk riparian areas annually. Treatments align with priority watersheds.
- Alternative 4: Mixed conifer with frequent fire: During each 10-year period following plan approval, treat at least 25,000 to 50,000 acres using a combination of prescribed fire and naturally ignited wildfire to make progress toward or to maintain desired conditions.
 - ◆ Ponderosa pine forest: During the 10 years following plan approval, treat at least 100,000 to 175,000 acres using a combination of prescribed fire and naturally ignited wildfire to make progress toward or maintain desired conditions.
 - ◆ Riparian: Moved objective to Wetland Jewels Management Area

There could be some localized adverse impacts to these individuals of species, but overall, if populations of non-mobile species (plants, microsite invertebrates, etc.) are not severely degraded species would continue to persist. Beneficial impacts include a slight improvement in potentially suitable ecological condition in frequent fire forests, riparian, and aquatic systems by increasing the amount of habitat in the desired seral states or properly functioning condition for breeding, roosting, and foraging. Objectives to treat acres in these departed systems would move those systems toward a vegetative or aquatic state more complementary to those species' evolution, especially goshawk.

On the Kaibab National Forest in Arizona, Reynolds et al. (2017) assessed the effects of mixed fire severity on goshawk productivity in the Warm Fire footprint, a 235-square-kilometer fire that burned in ponderosa pine and mixed-conifer forests. The focus of their study was to assess how low- and high-fire severity affected nest survival and productivity. They assessed post-fire activity at 20 territories in areas of high and low fire severity and found that territories that lost more than 75 percent of the forest to moderate- and high-severity fire were not reoccupied, while territories that lost between 50 to 75 percent of the forest to moderate and high severity had only 43 percent reoccupation following the fire. Post-fire occupancy of a nest area in a burned territory depended on the availability of at least one alternate nest stand in the territory that had escaped high-severity fire. Their study demonstrates management strategies for mixed fire. Ray and others (2014) found that forest treatments composed of thinning and prescribed fire in ponderosa pine forest had relatively minor effects on goshawk occupancy compared to stand-replacing fire that had occurred in the same area. Their study demonstrated active forest restoration is necessary to avoid more pronounced and widespread degradation or loss of habitat.

Eligible Wild and Scenic Rivers

A comprehensive evaluation of wild and scenic rivers was conducted as part of the plan revision process which resulted in 51 eligible wild and scenic river segments on the forest. This would have potentially beneficial impacts by limiting the types of instream infrastructure. Limiting the types of instream infrastructure would provide habitat connectivity and minimizing ground disturbance on wildlife, plant, and aquatic species that use riparian and aquatic habitat.

Designated Wilderness and Inventoried Roadless Areas

Designated wilderness (129,119 acres) and inventoried roadless (105,000 acres) areas provide beneficial impact for habitat connectivity and minimize disturbance to species of conservation concern through primitive management or lack of road construction.

Developed Winter and Summer Resort Management Area

The Developed Winter and Summer Resort Management Area comprises the permitted ski areas on the Carson. Under the 1986 Forest Plan, this management area is currently in an altered vegetative state from reference conditions and would continue to be managed as such under all alternatives. This management area could possibly decrease habitat connectivity within the boundaries of the management area for forested species of conservation concern such as northern goshawk. However, this management area could improve grassland habitat connectivity for masked shrew and other grassland wildlife dependent species. This management area would also increase ground disturbance from ski area development and increase human intrusive disturbance to these species under all alternatives. The substantive difference among alternatives for the Developed Winter and Summer Resort Management Area is under alternative 3, the management area is expanded by 921 acres around the Sipapu Ski and Summer Resort. The current Sipapu permitted boundary is 215 acres and would remain this acreage under all alternatives except alternative 3 where it would likely be expanded through a separate analysis. The effect of this change is discussed in Environmental Consequences – Alternative 3.

Jicarilla Natural Gas Management Area

All five alternatives include the Jicarilla Natural Gas Management Area. Under these alternatives, decisions regarding leasable mineral activities in the Jicarilla Natural Gas Management Area would align with law, regulation, and policy, and would be consistent with plan decisions for other resource areas to the extent possible.

Leasable mineral activities within the Jicarilla Natural Gas Management Area may have both short- and long-term adverse environmental consequences on species of conservation concern. Short-term effects could include increased human activity, such as motorized traffic, noise from drilling equipment, temporary roads, ground disturbance during drilling activities, and construction of authorized well pads, or pipelines. Long-term effects could include impacts operation and maintenance of the authorized facilities over the life of the facility. Operation and maintenance impacts may include increased human activity and noise, motorized vehicle traffic, or additional ground disturbance. The effects of these short- and long-term consequences could include wildlife displacement and habitat fragmentation.

Standards and guidelines requiring mitigation measures lessen these effects by protecting resources affected by mineral operations, including specific standards to ensure reclamation to stable, productive conditions consistent with forestwide desired conditions. Timing limitations on new drilling activity and completions limit disturbance and minimize risks to reproduction during critical breeding, rearing, and fledging periods. This ensures the health and persistence of these species on the landscape. Co-location of pipeline, road, and other infrastructure, road design limitations, and well siting measures that limit surface disturbance would decrease soil loss and compaction, vegetation removal, and habitat fragmentation. Avoidance of riparian areas would protect wildlife habitat and surface waters by reducing the probability for sedimentation along stream channels and spills near drainages.

Climate Change

Climate change has occurred to some degree and will continue in the future. Ramifications of a changing climate on wildlife are likely to include reduced snowfall or earlier snow melt in the spring, extended periods of drought or extended dry periods in the spring and summer, more frequent and larger wildfires, increased insect and disease-induced mortality, and changes in site characteristics that promote type conversion or vegetation community changes. This pattern is consistent with current trends in other parts of the West (Fettig et al. 2013).

These changes cause seasonal ranges and food sources for wildlife to shift and can affect the timing of reproduction. Reduced snowpack and changes in precipitation can affect amphibians by reducing water levels in lakes and ponds and can affect species that rely on deep or persistent snow. Forested tracts and remote habitats can also become isolated, reducing landscape connectivity and ecological condition for

species with limited dispersal ability. The timing of spring green up can also affect food availability for migratory birds or forage conditions for big game. Those species with highly specialized ecological condition requirements, at the edge of their range, currently in decline, and/or having poor dispersal abilities may be particularly at risk (National Fish Wildlife and Plants Climate Adaptation Partnership 2012).

Climate change presents an aspect of uncertainty in future conditions, disturbance regimes, and vegetative and wildlife responses. Strategies that can be used to help reduce impacts from climate change include managing for diverse conditions, maintaining healthy and connected populations, reducing the risk of large uncharacteristic fire, preventing and controlling invasive species, and ensuring ecosystem processes and habitat connectivity (The Heinz Center 2008). While how well each of the alternatives addresses these strategies varies, it is assumed that to a certain extent, climate change and associated effects to wildlife would occur under all alternatives. The Climate Vulnerability Assessment for the Carson (USDA FS 2014a) provides additional information on the vulnerability of the different vegetation communities and habitat types to climate change.

Summary

Under all alternatives, for all vegetation types except frequent fire forests, future management would be similar to current management, and consequently, environmental consequences are expected to be similar under all plan alternatives. All vegetation types are expected to remain either low to moderately departed (at risk) in the near and distant future ([Vegetation Communities and Fuels](#)). These same conditions and trends also apply to vegetation-related characteristics such as fire regime, patch size, species composition, ground cover, and soil condition, as these characteristics are intricately associated with, and are dependent on, vegetation structure.

The amount of high-elevation forest, non-forested, woodlands vegetation systems and abiotic features (including caves/mines, rocky outcrops, cliffs, canyon habitat, and soils) are not expected to change under any alternative. For the species of conservation concern bat species, American peregrine falcon, burrowing owl, and Gunnison's prairie dog that depend on these vegetation and ecological conditions, their persistence would be maintained through plan components that minimize risk for disturbance. Active management activities could affect individual animals but would not affect the species' capability to persist over the long term.

For all alternatives, future management is concentrated in the frequent fire forest, riparian, and aquatic systems, which are the most highly departed from reference conditions. Management intensity in these systems varies by alternative, but overall, all alternatives move the Carson toward the desired state (table 5).

Environmental Consequences for Species of Conservation Concern – Alternative 1

The existing 1986 Forest Plan was developed under the 1982 planning rule and does not include the species of conservation concern concept; however, species of conservation concern are included as part of the current analysis and would replace regionally sensitive species if alternative 1 was selected. In accordance with the 1982 planning rule, each proposed species is evaluated in terms of its ability to persist in the planning unit.

The key ecological conditions for species of conservation concern and the key threats affecting those conditions are described below for all action alternatives, which follows this section. Because the existing 1986 Forest Plan was not explicitly developed using the coarse-filter, fine-filter approach (a key tenet of the species diversity requirements under the 2012 rule), alternative 1 would be largely limited to plan direction from the 1996 amendment, best management practices, and site-specific mitigations done at the project level.

The 1986 Forest Plan, as amended lacks a description of desired conditions for many of the key ecological characteristics for species of conservation concern, making it harder to ensure projects are implemented in a consistent manner and that projects are moving toward a common set of desired conditions and long-term goals. Alternative 1 does not contain plan components that would retain species specific (fine-filter) wildlife, plant, and aquatic ecological condition such as guidance for rare endemic species, protections for cave-

dwelling mammals like bats, and measures that prevent the spread of certain invasive species including wildlife diseases (e.g., white-nose syndrome, chytrid fungus,) and predators (e.g., bull frog). Current direction for invasive species is primarily focused on noxious weeds. The current plan is also missing direction that influences animal movement and promotes connectivity of wide ranging species, such as vegetation patch dynamics. It does provide for protection against physical obstruction such as wildlife-friendly fences and fish passage.

The current 1986 Forest Plan does not define specific desired fire regimes or contain objectives for frequency of fire to maintain or improve stand structure, maintain or decrease fuel loads, or to achieve other resource benefits. With the continued lack of fire disturbance, the risk of losing frequent fire forest vegetation systems to stand-replacing wildfire and the resulting uncharacteristic open state increases over time. The potential loss of ecological condition components due to large, high-severity wildfires could have particularly negative effects on species like northern goshawk, pale Townsend's big-eared bat, spotted bat, Pagosa milkvetch, and robust larkspur. Frequent Fire Forest, Riparian, and Aquatic Systems are highly departed and trending away from reference conditions, this trend would continue ([Environmental Consequences for Vegetation Communities](#)). Alternative 1 would continue to maintain current rates of planned and unplanned natural ignition and mechanical vegetation treatment, which would move those vegetation states toward desired conditions at a slower rate than any of the action alternatives for Frequent Fire Forest species of conservation concern. Mixed conifer frequent fire would remain moderately departed under this alternative's desired condition after 15 years, but would move closer to the desired state, changing from a departure of 64 percent to 54 percent. Ponderosa pine forest would remain highly departed (82 percent), an improvement from current conditions (92 percent departure). This would be a slight overall improvement from current conditions.

Most of the standards and guidelines that have the potential to benefit wildlife in the current 1986 Forest Plan are also found in the action alternatives in the form of desired conditions, guidelines, or management approaches. In many places, the current 1986 Forest Plan reiterates existing law, regulation, or policy, but these are incorporated by reference in the action alternatives and are considered more specifically at the project level.

Prescriptive (restrictive) standards and guidelines in the current 1986 Forest Plan make it difficult to apply adaptive management as our understanding about management effects on ecosystems and wildlife changes. Adaptive management will be essential to effectively manage for climate change and invasive species in changing and uncertain conditions. Current direction for invasive species is primarily focused on noxious weeds. Climate change has the potential to affect all wildlife and plant species, and influences the likelihood of large-scale disturbance (e.g., fire, bark beetle outbreaks) across the landscape. Alternative 1 does not recognize climate change and offers limited guidance associated with management activities (e.g., salvage logging, blow down) related to such disturbance events. Guidance for salvage operations is general in nature and focuses more on the enhancement of timber production rather than an integrated approach that balances management with other resource values such as wildlife habitat. The forest would continue to follow existing law, regulation, policy, and best management practices to address species viability concerns in areas affected by large-scale disturbance.

There is no recommended wilderness under alternative 1.

Summary

In summary, alternative 1 has general direction to protect the diversity of wildlife and plant communities and seral stages, however, plan direction is based on outputs, rather than outcomes, and fails to address current scientific thinking on the use of wildland fire and vegetation management as a way to promote ecological integrity, resilience, and wildlife diversity. Projects and activities would be guided by agency direction for managing Federally Listed Species and direction to manage Regional Forester's sensitive species. Species of conservation concern would continue to persist under this alternative; however, this alternative would make

the overall slowest progress for the most species in terms of wildlife ecological condition improvement out of all the alternatives.

Alternative 1 fails to address or poorly addresses the following over the life of the plan:

- Restoration would not happen at the pace and magnitude needed to have a marked effect on ecological resilience in a timely manner.
- Climate change, connectivity, and noxious invasive weeds are not explicitly recognized or incorporated.
- Conflicting management direction for some species (e.g., northern goshawk and Mexican spotted owl).
- Monitoring plan lacks integration across resource areas, was not designed with the concept of adaptive management, and does not consider key ecological conditions for species of conservation concern.
- There is no clear direction for watershed improvement or overall riparian health.
- There is no clear direction for specific plant species improvement or how to improve soil condition.
- Not based on current and emerging best available scientific information.
- Not developed using coarse-filter/fine-filter process to provide for species of conservation concern.

Environmental Consequences for Species of Conservation Concern Common to Action Alternatives 2, 3, 4, and 5

Action alternatives 2, 3, 4, and 5 are more strategic in nature and integrated than the current 1986 Forest Plan (alternative 1). All action alternatives were developed using the coarse-filter/fine-filter approach to develop plan components to support species of conservation concern from the 2012 Planning Rule (appendix H). This approach is critical in enabling the adaptive management feedback loop between the plan and the plan monitoring program and helps ensure that the ecological conditions for species of conservation concern species are maintained and will provide for their persistence. All action alternatives include plan direction designed to maintain the diversity of plant and animal communities and support the persistence of native species within the plan area, subject to the extent of Forest Service authority and the inherent capability of the plan area.

Substantive differences among action alternatives include six place-based management areas each having their own set of plan components. Other substantive differences between action alternatives that could impact wildlife include the amount of recommended wilderness being proposed, the role of mechanical treatments and wildland fire as restoration tools, the amount of riparian/aquatic systems restored, and the amount of roads maintained or decommissioned for ecosystem health. Current science recognizes both wildland fire and vegetation management as tools through which ecological integrity and resilience can be managed (C. Miller and Aplet 2016; Reynolds et al. 2013). The action alternatives more proactively incorporate this thinking. All action alternatives would provide for a substantial increase in both prescribed fire and unplanned natural ignitions that are managed for resource benefits. This would have positive effects for species that use frequent fire forest as well as riparian and aquatic associated species by decreasing the chance for stand-replacing fires, and thereby decreasing sedimentation from fire flood events. The action alternatives also make better use of partnerships and collaboration to maintain ecosystem integrity and resilience. Current science suggests that conservation partnerships are becoming increasingly important to adaptively manage for climate change (Monahan and Theobald 2018).

As mentioned in alternative 1, adaptive management will be essential to effectively manage for climate change and associated impacts from disturbance events, livestock grazing, and invasive species in changing and uncertain conditions. As a result, the action alternatives include a monitoring plan designed to better inform the effects and effectiveness of management and progress toward desired conditions. Alternatives 2 through 5 better recognize and address the negative effects non-native invasive species and disease can have on ecosystem integrity and biological diversity. Direction for invasive species was updated and expanded to recognize the threats to ecosystem resilience from all nonnative, invasive, aquatic and terrestrial plants and

animals likely to cause harm to ecosystems. Finally, climate change may push rare and endemic species to the limits of their range and evolutionary capacity. This is expected to be especially significant in the Southwest, an area already affected by long-term drought. The action alternatives recognize and include plan components to help address that threat and to reduce the risk of removing ecological condition for those types of species.

For some species, where disease is a primary risk factor, it will be hard for the forest to mitigate risk beyond the forest boundaries. This includes species of conservation concern species, pale Townsend's big eared bat, spotted bat, western boreal toad, northern leopard frog, burrowing owl, and Gunnison's prairie dog. For these species, it will be difficult to prevent intermingling with diseased animals that may come and go from the forest. Effects of all action alternatives for these species would be similar as they relate to managing for the outbreak or continuation of disease contact or spread for species of conservation concern.

Recommended wilderness is proposed under alternatives 2, 4, and 5 (table 36). Recommended wilderness beneficially effects species of conservation concern through its primitive management, which minimizes disturbance to species of conservation concern and provides habitat connectivity. However, the Carson would also be more limited in its ability to treat these areas and would rely on wildland fire as its main restoration tool. Limiting the ability to treat these areas may leave these areas vulnerable to large stand-replacing wildfire and cause these areas to become more departed in the future. More departed ecological conditions in the future may negatively affect species of conservation concern dependent on this habitat by altering seral state conditions. Alternative 2 identifies 9,189 acres for recommended wilderness, while alternative 5 would include the most recommended wilderness (67,996 acres).

Explicit forestwide plan direction that includes beneficial language to mitigate negative impacts on species of conservation concern and wildlife, in general, for climate change, nonnative invasive species, disease, and connectivity which are missing from Alternative 1 include, but are not limited, to plan components found in table 37 to table 39 of the Federally Listed Species section.

These plan components would be beneficial for all wildlife, plant, and aquatic species but especially those species that depend on riparian systems, frequent-fire adapted ecosystems, aquatic systems, endemic species/species with restricted distributions, and species that move across large landscapes and use habitat at multiple spatial scales. These plan components would benefit wildlife species by supporting resilient and resistant ecosystems and watersheds, which would protect species from the negative effects of climate change and would give wildlife species the best opportunity to adapt to changing conditions. This type of plan language, which can be found in the action alternatives, is not explicitly called out under alternative 1 and should have a more positive effect, as stated above on all species of conservation concern under all action alternatives.

Species of conservation concern and their key ecological components and threats are broadly defined below. Species have been grouped according to their primary ecological needs and threats to eliminate redundancy in the analysis. Refer to the affected environment ([Ecological Conditions](#)) for the vegetation community and current departure and trend for each vegetation community associated with species of conservation concern species. The forestwide plan components described below would apply to species of conservation concern across all action alternatives.

All Forested Ecosystems including Frequent Fire Forest

(BP, SFF, MCW, MCD, PPF, PJO, PJS): Northern goshawk, pale Townsend's big-eared bat, spotted bat, pinyon jay, Ripley's milkvetch, American peregrine falcon, robust larkspur, and Chama blazing star.

- Key Ecological Conditions: Structurally diverse mature forests (seral state), conifer forest, structural heterogeneity, interlocking canopy.

- Key Threats: Risk of loss of ecological condition and habitat fragmentation of conifer forest from wildfire outside the natural range of variability; fire suppression, fuelwood collection, ungulate grazing, recreation, and climate change.

Northern goshawk and Ripley's milkvetch would benefit primarily from objectives that move highly departed Frequent Fire Forest toward a more desired state. The objectives and effects differ across the action alternatives and the total amount of ecological condition moved toward desired conditions over the 15-year life of the plan varies across alternatives. The differing amounts of ecological condition improved are highlighted in the individual sections for each alternative in their respective vegetation sections. High-elevation forest and woodlands are only low to moderately departed from reference conditions, as such, objectives were not identified for these systems under the action alternatives.

Coarse filter

Coarse-filter plan components that would benefit the majority of species that depend on forested ecosystems include desired conditions to maintain appropriate structure, composition, and function at the landscape (1,000 to 10,000 acres or more), mid- (100 to 1,000 acres) and fine-scales (less than 10 acres). Forests that have departed structure also have departed fire regime condition class. Restoring vegetation structure in Frequent Fire Forest through vegetation management and fuels reduction projects will improve fire regime condition class and reduce the risk of stand-replacing fire. Desired conditions that incorporate varying structural stages, including uneven-aged forest with openings, occasional even-aged structure with large snags and abundant understory (e.g., coarse woody debris, logs), and old-growth components would guide the implementation of forest management activities that would move Frequent Fire Forest toward a more favorable departure and trend from that which currently exists. The full range of life stage needs for rare and endemic plants and terrestrial wildlife (e.g., fledging, nesting, dispersal, roosting), as well as conditions that would support an adequate prey base for foraging are provided for at the landscape (FW-VEG-MCD-DC 1-2, 4, FW-VEG-PPF-DC 1-2, FW-VEG-PPF-DC 4-7); mid (FW-VEG-MCD-DC 8-12, FW-VEG-PPF-DC 8-10); and fine scales (FW-VEG-MCD-DC 16, 18, and 19, FW-VEG-PPF-DC 15-18, FW-VEG-SFF-G 2-4, FW-VEG-ASP-G 3, FW-VEG-MCW-G 3-5, FW-VEG-MCD-G 3-5, and FW-VEG-PPF-G 5-7).

Where Gambel oak and other hardwoods occur as a component in conifer forest, desired conditions (FW-VEG-MCD-DC 14 and FW-VEG-PPF-DC 11) would promote their retention during project design to promote canopy cover and moister site conditions for small mammals, plants, and insects. Retention of oaks would promote biodiversity and abundant prey for foliage gleaners as well as apex predators.

Although there are no objectives identified for high-elevation forest or woodlands, desired conditions would ensure appropriate composition, structure, and function are accounted for at the landscape (FW-VEG-BP-DC 1, FW-VEG-SFF-DC 1-2, 4, FW-VEG-MCW-DC 1-2, FW-VEG-MCW-DC 4-6, FW-VEG-PJO-DC 1-3, FW-VEG-PJO-DC 7-8, FW-VEG-PJS-DC 1-2, FW-VEG-PJS-DC 7-8); mid (FW-VEG-BP-DC 6-7, FW-VEG-SFF-DC 8-9 and 14, FW-VEG-MCW-DC 8-12, FW-VEG-PJO-DC 9-10, FW-VEG-PJS-DC 9-10); and fine scales (FW-VEG-SFF-DC 15, FW-VEG-MCW-DC 15, FW-VEG-PJO-DC 13, FW-VEG-PJS-DC 15).

Additional coarse-filter plan components under the Wildland Fire Management resource area promote endemic levels of disturbance, natural fire regimes, and restoration activities that would allow all forest ecosystems to be resilient in the face of climate change, drought, and other disturbance. These include: (FW-FIRE-DC 1-2; FW-FIRE-G 1, 3, 7). A forestwide component specific to disturbances and climate change in the all Vegetation section (FW-VEG-DC 2) further supports ecosystem resiliency.

The Sustainable Forestry and Forest Products resource area would ensure that private and commercial timber harvest is used as a restoration tool and desired conditions for this resource (FW-FFP-DC 4-5) would ensure these types of activities are done in a way that enhances wildlife and aquatic ecological condition. Within this section are vegetation management standards (FW-FFP-S 1 and 2) that would mitigate habitat disturbance and damage that might occur as a result of timber harvest, so watershed conditions are protected, and ecological needs of wildlife and aquatic species are maintained.

Livestock management has the potential to affect habitat for prey species and direct harm to plant species. A desired condition (FW-GRZ-DC-4) and a standard (FW-GRZ-S-1) for livestock grazing strive for compatibility with ecological functions and processes (such as water infiltration, wildlife habitat, soil stability, and natural fire regimes) and resilient ecosystems that are consistent with plan components for forested ecosystems and riparian habitat. In addition, desired condition (FW-GRZ-DC-5) emphasizes native plant communities with a diversity of shrubs and understories of grasses. These components promote understory and grassland to help improve habitat conditions for prey species across the Carson. These plan components would complement and reinforce desired conditions in forested vegetation types and help to ensure that understory development is balanced with grazing management and the needs of wildlife species.

A guideline (FW-GRZ-G-1) would balance forage use with desired ecological conditions and livestock grazing during permit renewals and development of annual operating instructions.

Fine Filter

In addition to the ecosystem-based components highlighted above, a number of fine-filter, species-specific plan components were added to address the needs of the species of conservation concern.

Additional fine-filter plan components (FW-VEG-SFF-DC 13 and G 2-4, FW-VEG-MCW-DC 10, FW-VEG-MCD-DC 12, FW-VEG-PPF-DC 13, FW-VEG-PJO-DC 3 and 7) were added to meet the breeding, foraging, and roosting needs of northern goshawk and pinyon jay at the mid-scale ([Species Status, Key Ecological Conditions and Threats](#)).

The following guidelines were added to mitigate disturbance from project management activities that might cause disturbance during breeding season for pinyon jay and nest failure during the breeding season for goshawk and peregrine falcon:

- FW-VEG-G 3 Vegetation should provide for at-risk species' habitats, by minimizing disturbance, providing recovery strategies, and managing for desired levels of key structural elements (e.g., large old trees and snags, downed woody debris, denser vegetation structure, and soil structure) important for nesting, rearing, breeding, foraging, dispersal, and other life history needs, to maintain the persistence or contribute to the recovery of at-risk species.
- FW-WFP-G 3 Management activities should avoid disturbance at known active raptor nests and fledging areas, to maintain the persistence or contribute to the recovery of at-risk species. Timing restrictions, adaptive percent utilizations, distance buffers, or other means of avoiding disturbance should be based on the best available scientific information, as well as on site-specific factors (e.g., topography and available habitat).⁶
- FW-VEG-SFF-G 5, ASP-G 4, MCW-G 6, MCD-G 6, and PPF-G 8 Human presence should be minimized in occupied goshawk nest areas during nesting season of March 1 through September 30, to maintain the persistence or contribute to the recovery of at-risk species.
- FW-VEG-PJO-G 1 and PJS-G 4 Treatments in PJO should leave key habitat features (i.e., roosting trees, snags, partially dead or dying trees, large trees, or downed logs) and single or small groups of medium to large native trees that are widely spaced, with expanses of herbaceous vegetation and coarse woody debris, to provide for soil productivity, traditional uses (e.g., piñon nut gathering), and wildlife needs, such as foraging habitat for at-risk species, migratory birds, and other piñon-juniper obligate species.
- FW-VEG-PJO-G 2 and PJS-G 3 Treatments in PJO should avoid creating a sharp, well-defined edge between dense woodlands and recovered shrublands, to provide foraging habitat of at-risk species.

Additional fine-filter plan components listed below were added to identify key ecosystems characteristics associated with Ripley's milkvetch, Chama blazing star, and robust larkspur.

⁶ Birds known to have established nests near preexisting human activities are assumed to be tolerant of the level of activity present when the nest was established.

- FW-VEG-DC 19 At-risk plant community habitats (e.g., gypseous or limy sandstones; Mancos Shale soils; margins of springs; basalt lava flows and cinders; calcareous soil and alkaline clay; canyons, cliffs, and ledges; granitic soils and igneous rocks; and sandstone rocks and soils) are present, to maintain self-sustaining populations of associated at-risk plant species.
- FW-VEG-S 1 Collection of plant at-risk species shall be for research or scientific purposes only.
- FW-VEG-G 3 Vegetation should provide for at-risk species' habitats, by minimizing disturbance, providing recovery strategies, and managing for desired levels of key structural elements (e.g., large old trees and snags, downed woody debris, denser vegetation structure, and soil structure) important for nesting, rearing, breeding, foraging, dispersal, and other life history needs, to maintain the persistence or contribute to the recovery of at-risk species.
- FW-VEG-SFF-DC 16 and MCW-DC 17 Moist soil conditions (e.g., thick litter layers, wet areas, coarse woody debris, and decaying debris) are maintained and well distributed, within the capacity of the vegetation community for at-risk species.
- FW-VEG-PPF-DC 19, PJO-DC 14, and PJS-DC 16 Rocky features, outcrops of gypseous or limy sandstones, volcanic substrate soils, and Mancos Shale soils are present and provide habitat within the capacity of the vegetation community for at-risk species.

Determination: For species that use all forested ecosystems, including frequent fire forest, and that depend on interlocking canopies, the ecosystem-level plan components should provide the ecological conditions necessary to maintain persistence for most species in the plan area. However, additional species-specific components have been added to maintain persistence of northern goshawk, pinyon jay, Ripley's milkvetch, robust larkspur, and Chama blazing star. The combination of ecosystem and species-specific plan components should provide the ecological conditions necessary to maintain persistence in the plan area.

Large trees, coarse woody debris, and snag associates

(BP, SFF, MCW, MCD, PPF, PJO, PJS, SAGE): Northern goshawk, masked shrew, and pinyon jay

- Key Threats: Vegetation management and fire (both unplanned natural ignited and prescribed), fuelwood collection, natural disturbance (e.g., insect outbreaks, drought), and climate change.

Coarse filter

Many of the species that need diverse forest structure and old-growth components are also dependent on large trees, coarse woody debris, snags, and tree-related components for roosting, foraging, and nesting. Downed woody material and logs provide important ecological condition for small mammalian prey species. In addition to the components described above these species would also benefit from a number of ecosystem-level plan components which would protect these key ecological conditions.

Coarse-filter plan components that would benefit the majority of species that depend on these vegetation communities include desired conditions to maintain appropriate levels of old trees, snags, nesting structures (e.g., witches brooms), and downed wood at multiple spatial scales. Forestwide desired conditions for the different vegetation community include the landscape (FW-VEG-DC 1-4; FW-VEG-SFF-DC 3-4; FW-VEG-MCW-DC 4-6; FW-VEG-MCD-DC 4-6; FW-VEG-PPF-DC 5-7) and mid (FW-VEG-SFF-DC 8-9; FW-VEG-MCD 13; FW-VEG-PPF-DC 10).

Forestwide components for All Vegetation communities include guidelines that would leave adequate number of snags, large trees, and coarse woody material (FW-VEG-G 3 and 4). There are also plan components that balance the needs of multiple use with wildlife species that need large trees and snags (FW-REC-G 1). Guideline 1 in Recreation would minimize impacts to these habitat features in developed and dispersed recreation sites. Ponderosa Pine includes guideline FW-VEG-PPF-G 1, that vegetation treatments should be designed to assure continuous recruitment of old-growth characteristics across the landscape over time.

There are also plan components that balance the needs of multiple use with wildlife species that need large trees and snags (FW-REC-G 1). Guideline 1 in Recreation would minimize impacts to these habitat features in developed and dispersed recreation sites. Guidelines within soil, vegetation, and fire (FW-SL-DC 1-2, FW-SL-G 1, FW-VEG-SFF-G 1, FW-FIRE-G 9) would ensure sufficient levels of woody debris are maintained during projects and would mitigate negative effects that occur from ground-disturbing activities and prescribed burns that cause soil loss, erosion, compaction, and scarification.

Pinyon jays that use piñon-juniper, particularly tree components including large old trees and snags for roosting, nesting and foraging, would benefit from landscape-scale desired conditions that promote heterogeneity and old-growth components in piñon-juniper woodland and piñon-juniper sagebrush (FW-PJO-DC 1-3, FW-PJO-DC 7-8, PW-PJS-DC 1, and FW-PJS-DC 7-8). Since fuelwood removal can deplete these components on the landscape, Sustainable Forestry and Forest Products has a desired condition that would minimize the harvest of these ecological elements (FW-FFP-DC 4-5). This desired condition would mitigate this threat by ensuring private and commercial timber harvest enhances and supports wildlife ecological condition, particularly with regard to snags and dying trees.

Fine filter

In addition to the ecosystem-based components highlighted above, a number of fine filter, species-specific plan components were added to address the needs of the species of conservation concern that utilize tree features. These include:

Landscape-Scale Desired Conditions (1,000 to 10,000 plus acres)

- FW-VEG-MCW-DC 6, MCD-DC 6, and PPF-DC 7 Dwarf mistletoe infestations may be present in stands with a Douglas-fir or spruce component, but rarely in other tree species. Infestation size, severity, and amount of mortality varies among infested stands. Witches' brooms may be scattered throughout the infestations, providing structural diversity in the stand and improved foraging and nesting habitat for wildlife species, such as small mammals (e.g., tree squirrels) and raptors (e.g., goshawks and red-tailed hawks).

Mid-Scale Desired Conditions (10 to 1,000 acres)

- FW-VEG-SFF-DC 13, MCW-DC 10, MCD-DC 12, and PPF-DC 13 Forest conditions in goshawk post-fledging family areas are generally consistent with surrounding forest conditions, except these forests contain 10-20 percent greater tree density (basal area) than goshawk foraging areas and the general forest. Goshawk nest areas have forest conditions that are multi-aged but are dominated by large trees with relatively denser canopies than other areas.

Fine Scale Desired Conditions (10 acres or less)

- FW-VEG-BP-DC 8, SFF-DC 16, and MCW-DC 17 Moist soil conditions (e.g., thick litter layers, wet areas, coarse woody debris, and decaying debris) are maintained and well distributed, within the capacity of the vegetation community for at-risk species.

Guidelines

- FW-VEG-PPF-G 1 Vegetation treatments should be designed such that structural stages and age classes are proportionally represented to assure continuous recruitment of old-growth characteristics across the landscape over time.
- FW-VEG-MCW-G 1, MCD-G 1, and PPF-G 3 Slash piles should be retained across the landscape for several years, to increase small mammal occupancy in areas where coarse woody debris is deficient and provide nesting habitat and cover for associated wildlife species (e.g., turkeys, birds, small mammals, reptiles, and invertebrates).
- FW-VEG-PJO-G 1 and PJS-G 4 Treatments in PJO should leave key habitat features (i.e., roosting trees, snags, partially dead or dying trees, large trees, or downed logs) and single or small groups of medium to

large native trees that are widely spaced, with expanses of herbaceous vegetation and coarse woody debris, to provide for soil productivity, traditional uses (e.g., piñon nut gathering), and wildlife needs, such as foraging habitat for at-risk species, migratory birds, and other piñon-juniper obligate species.

- FW-VEG-PJO-G 2 and PJS-G 3 Treatments in PJO should avoid creating a sharp, well-defined edge between dense woodlands and recovered shrublands, to provide foraging habitat of at-risk species.

Determination: For species that depend on large trees, snags, and coarse woody debris, the ecosystem-level plan components should provide the ecological conditions necessary to maintain persistence for most species in the plan area. However, additional species-specific components have been added to maintain persistence of northern goshawk, pinyon jay, and masked shrew. The combination of ecosystem and species-specific plan components should provide the ecological conditions necessary to maintain persistence in the plan area.

Non-forested Vegetation System Associates

(ALP, MSG, and SAGE): American peregrine falcon, white-tailed ptarmigan, alpine larkspur, Gunnison's prairie dog, burrowing owl, masked shrew, spotted bat, Ripley's milkvetch, and tufted sand verbena

- Key Ecological Conditions: diverse herbaceous and shrub composition and structure (herbaceous understory or open seral states), burrows and soil which supports nesting and or burrowing, adequate forage, tall grasses for cover and foraging.
- Key Threats: invasive plants, conifer/ woodland encroachment, loss of forage, unmanaged grazing/herbivory, soil disturbance from multiple uses (e.g., trails, recreation, and grazing), disease.

Coarse Filter

Persistence for species that utilize non-forested vegetation system is largely realized through desired conditions for Sagebrush (SAGE), Montane and Subalpine Grassland (MSG), Alpine Tundra (ALP), Recreation (trails), Sustainable Rangeland and Livestock Grazing (GRZ), and Sustainable Forestry and Forest Products (FFP) resource areas.

The full range of life stage needs for rare and endemic plants and terrestrial wildlife (e.g., fledging, nesting, dispersal, roosting), as well as conditions that would support an adequate prey base for foraging are provided for at the landscape (FW-VEG-ALP-DC 1-2; FW-VEG-ALP DC 6-8; FW-VEG-MSG-DC 1-3; FW-VEG-SAGE-DC 1-3); mid (FW-VEG-MSG-DC 10-11); and fine scales (FW-VEG-MSG-DC 14).

Gunnison's prairie dog, burrowing owl, masked shrew, and plant species are heavily affected by soil conditions. There are several plan components for the purpose of improving soil conditions, which would improve persistence for each of the plan species in this section.

Desired conditions (FW-VEG-DC 8, FW-VEG-MSG-DC 4, 7, 10-11, FW-VEG-SAGE-DC 9, AND FW-DC-SL-DC 1-3) would ensure soil condition is satisfactory, and functioning properly as defined by current Forest Service protocols.

Management approach 5 within all vegetation (VEG) suggests using methods, such as fencing, aerating soil (decompacting soils), improving livestock grazing strategies, or strategically locating constructed waters or roads to protect and enhance grassland composition, structure, and productivity and soil function.

Desired conditions for sagebrush (FW-VEG-SAGE-DC 1-3) would ensure enough shrub cover exists for sagebrush obligate species. While desired conditions (FW-VEG-ALP-DC 1 and 5, FW-VEG-MSG-DC 1, 6, and 9) would maintain appropriate seral states and fire regimes are within montane subalpine grassland and alpine and tundra.

Livestock grazing can trample, alter plant community structure, species composition, relative abundance of species, and vegetative density. Sustainable Rangeland and Livestock Grazing Plan components (FW-GRZ-DC 4-5, FW-GRZ-S 1, FW-GRZ-G 5) would ensure livestock grazing is compatible with wildlife needs, that shrubs and forbs are available, and that grasslands provide adequate cover to sustain species like prairie dog,

burrowing owl, masked shrew, and northern leopard frog. Species that use non-forested ecosystems would also benefit from plan components under the Soils section. Standards and guidelines for soils would mitigate negative effects that occur from ground-disturbing activities that cause soil loss, erosion, and compaction (FW-SL-G 1-2; FW-VEG-MSG-S 1; FW-VEG-MSG-G 1).

Fine Filter

Additional guidelines were added to ensure protective measure are included for species of conservation concern, during project design:

- FW-VEG-ALP-G 1 Trail construction and maintenance in ALP should minimize disturbance to at-risk plants and to important key habitat features (e.g., rock outcrops, willows, and talus slopes) for at-risk species and other alpine-dependent species (e.g., yellow-bellied marmot and American pika), to maintain the persistence of native species.
- FW-VEG-ALP-G 2 To assist breeding, nesting, and reproductive success of at-risk species, adaptive seasonal use or percent utilizations for livestock grazing should be considered and based on the best available scientific information, as well as on site-specific factors (e.g., topography and available habitat).
- FW-GRZ-G 4 New range infrastructure (e.g., troughs, tanks) should be designed to avoid long-term negative impacts to soil resources (e.g., soil compaction and soil loss), to maintain hydrological function outside the structures' footprint.
- FW-GRZ-G 5 Salting or mineral supplementation should not occur on or adjacent to areas (e.g., known at-risk plant species habitat, riparian areas, wetlands, or archeological sites) that are especially sensitive to salt and to increased traffic from ungulates, to protect these sites.
- FW-REC-G 1 Recreation activities should be compatible with and managed adaptively to minimize impacts to at-risk species and ecological desired conditions, including in riparian management zones (e.g., along streams, around seeps, springs, lakes, and wetlands).
- FW-TFA-G 6 Road and trail construction and maintenance activities should avoid or minimize habitat disturbance of known at-risk species, to maintain the persistence of at-risk species.
- FW-TFA-G 9 Where recreation or other management activities have the potential to trample known populations of at-risk plant species, signs should be posted educating the public to stay on designated trails and avoid impacts.

Finally, although the threat from sylvatic plague in prairie dogs and burrowing owls are largely beyond the management authority of the Carson, Management Approach 10 in the Wildlife, Fish, and Plants section was added to encourage collaboration and actions that help maintain range-wide species persistence.

Determination: For species that use non-forested vegetation systems, the ecosystem-level plan components and species-specific plan components should provide the ecological conditions necessary to maintain persistence for most species in the plan area.

Riparian Associates

(Wetland Riparian and Forest and Shrub Riparian): Northern leopard frog, western boreal toad, American peregrine falcon, Wilson's warbler, Nokomis fritillary butterfly, masked shrew, spotted bat, water shrew, Arizona willow, and robust larkspur

- Key Ecological Conditions: diverse herbaceous and shrub riparian composition and structure
- Key Threats: Loss of riparian ecological condition due to changes in runoff or diversion, invasive plants, sedimentation, and soil compaction from roads and or activities such as grazing, vegetation, fire, and recreation management; disease.

Riparian habitat includes wetlands and forested riparian (i.e., willow, cottonwood, and alder) areas surrounding seeps and springs, perennial streams, lakes, and other water features. Riparian habitat occupies a small portion of the forest and ranges from low to highly departed, depending on elevation. Species associated with this type of ecological condition would benefit from plan objectives that move riparian, including wetlands, ecological conditions toward the desired state. The objectives and effects differ across action alternatives and the total amount of ecological condition moved toward desired conditions over the 15-year life of the plan varies for each habitat type across alternatives. The differing amounts of ecological condition improved are highlighted in the individual sections for each alternative in their respective sections.

Plan components that would benefit the majority of species that depend on these vegetation communities can be found under the Watershed and Water, Riparian Management Zones, Wetland Riparian, Forest and Shrub Riparian, Nonnative Invasive Species, Wildlife, Fish, and Plant, All Vegetation, and Fire and Fuels sections of the action alternatives. Additional plan components that balance multiple use with wildlife needs can be found under the Sustainable Grazing and Livestock Management, Roads, and Mineral and Mining sections.

Coarse Filter

Desired conditions within the Watershed, Riparian Management Zone, Wetland Riparian, and Forest and Shrub Riparian resource sections (FW-WSW-DC 1-3; FW-WSW-RMZ-DC 1-8; FW-WSW-RMZ-WR-DC 1-3; FW-WSW-RMZ-FSR-DC 1-6) would move these systems toward proper functioning condition, while balancing multiple uses with ecological integrity. These components would help to minimize water diversions and improve hydrologic function, while maintaining systems that are resilient to climate change and associated disturbances such as fire. Watershed guideline (FW-WSW-G 1) would ensure that best management practices are applied to every site-specific project that has the potential to effect watershed conditions. Several standards and guidelines (FW-WSW-G 2; FW-WSW-RMZ-G 1-4; FW-WSW-RMZ-WR-S 1-3) would mitigate adverse effects from road construction or reconstruction (which can cause sedimentation) and would also rehabilitate in-stream structures, which could improve hydrologic function.

Livestock grazing can trample, alter plant community structure, species composition, relative abundance of species, vegetative density, and alter stream channel morphology for these riparian species. Plan components for the sustainable rangelands and livestock grazing program areas (FW-GRZ-DC-4-6; FW-GRZ-S-1; FW-GRZ-G-2-3) emphasize that livestock grazing within riparian management zones must be compatible with ecological function and the needs of at-risk species, and that desired conditions for riparian vegetation and proper stream channel morphology and floodplain function are sustained. These plan components would be beneficial by balancing multiple use with healthy riparian systems. Over the last decade, the Carson range staff has worked with partners and permit holders to manage grazing pressure on sensitive areas (such as critical areas and riparian areas).

Standards for Sustainable Forestry and Forest Products (FW-FFP-S 1-2) would protect the ecological integrity of watershed conditions by minimizing potentially adverse effects that could cause soil erosion and sedimentation during timber harvest operations. Plan components for the Sustainable Rangelands and Livestock Grazing, Riparian Management Zones resource (FW-GRZ-DC 4-6; FW-GRZ-S 1, FW-GRZ-G 1-3, 5; FW-WSW-RMZ-G 2, FW-WSW-RMZ-STM-DC 11; FW-WSW-RMZ-WB-DC 6) would ensure associated management activities are compatible with ecological function and supportive of diverse native plant communities including in wetland and riparian areas or riparian management zones.

For species such as bats that use artificial structures such as stock tanks and drinkers, a standard under Grazing Management (FW-GRZ-S 3) would ensure structures do not trap those species. Several guidelines (FW-GRZ-G 3-5) prevent the construction of new structures in riparian management zones and minimize potentially adverse effects that the construction of such structures may have on soils and hydrologic function of natural springs sources.

Desired condition 1 within the Minerals and Mining resource section would minimize impacts to surface and groundwater resources while facilitating the development of minerals. Guideline under the Riparian Management Zone resource section (FW-FW-WSW-RMZ-G2) would protect riparian areas from streambed

and flood plain alteration while standards and guidelines for the Transportation and Forest Access and Special Use resource sections (FW-TFA-G 2-4; FW-SU-S 2; FW-SU-G 4) would minimize disturbance (e.g., water flow, sedimentation) from the construction of roads and energy corridors by including mitigations to limit disturbance during project-level design.

Nonnative plant species can outcompete native species, causing reduction in suitable habitat and alterations in riparian function, while nonnative invasive animals and pathogens can cause direct mortality and predation. These threats are reduced through plan components in the Nonnative Invasive Species and Wildland Fire Management resource sections of the plan through desired conditions, standards, and guidelines (FW-NIS-DC 1; FW-NIS-S 1-2; FW-NIS-G 1, 3, 5-6; FW-FIRE-G 2-3) that minimize impacts to wildlife in riparian areas, and would also prevent pathogen transmission.

Fine Filter

Plan components were specifically added to mitigate the specific risk from invasive species and disease on northern leopard frog and western boreal toad, to ensure vegetation requirements needed by species of conservation concern species (Wilson's warbler, Arizona willow, Nokomis fritillary butterfly) are not removed during project-level activities, and that multiple uses (grazing, vegetation treatment and recreation) minimize impacts on all riparian associate species of conservation concern.

The following standards and guidelines were added to mitigate the specific risk from invasive species and disease on northern leopard frog and western boreal toad:

- FW-WSW-RMZ-STM-S 1, WB-S 1, SNS-S 1, Management activities in and around streams shall use decontamination procedures to prevent the spread of non-desirable fungus, disease, nonnative and invasive biota.
- FW-NIS-S 2 Projects, authorized activities, and special uses shall be designed (e.g., weed-free hay, off-highway vehicle washing, waders) to reduce the potential for introduction of new species or spread of existing invasive or undesirable aquatic or terrestrial nonnative populations.
- FW-NIS-G 1 When drafting water from streams or other waterbodies, measures should be taken to prevent entrapment of fish and aquatic organisms and the spread of parasites or disease (e.g., chytrid fungus, Didiymo, and whirling disease).
- FW-NIS-G 6 Preventive measures, such as requiring pre- and post-work cleaning of equipment and using certified weed-free seed, should be implemented through contracting, permitting, and other administrative processes. Weed-free plant material should be selected for all seeding and mulching projects, to restore natural species composition and ecosystem function to the disturbed area. Plant or seed materials should be used, which are appropriate to the site, capable of becoming established, and are not invasive.

Additional fine-filter plan components listed below were added to identify key ecosystems characteristics associated with Wilson's warbler, Arizona willow, and Nokomis fritillary butterfly.

- FW-VEG-G 2 and FW-WFP-G 2 Where the Forest Service has entered into a signed conservation agreement that provides guidance on activities or actions to be carried out by the Carson, those activities or actions should be undertaken consistent with the guidance found within the conservation agreement, to maintain the persistence or contribute to the recovery of federally listed species and persistence of species of conservation concern.
- FW-WSW-RMZ-DC 2 Riparian vegetation, particularly native species, support a wide range of vertebrate and invertebrate animal species. There is adequate recruitment and reproduction to maintain diverse native plant species composition indicative of the soil moisture conditions for the site.
- FW-WSW-RMZ-WR-DC 1 Necessary soil, hydrologic regime, vegetation, and water characteristics of WR sustain the system's ability to support unique physical and biological attributes and the diversity of

associated species (e.g., shrews and voles). Soils' ability to infiltrate water, recycle nutrients, and resist erosion is maintained and allows for burrowing by at-risk species.

- FW-WSW-RMZ-WR-DC 4, FSR-DC 9 Microhabitat condition for bog violet (soggy soils under shrubs and willows) is present, within the capability of vegetation conditions for at-risk species.
- FW-WSW-RMZ-WR-DC 5, FSR-DC 10 Nectar sources (e.g., thistle, horsemint, and Joe-pye weed) are available for at-risk species.
- FW-WSW-RMZ-FSR-DC 4 Riparian forest vegetation provides nesting and foraging habitat for Neotropical migrant birds, raptors, and cavity-dependent wildlife.
- FW-WSW-RMZ-FSR-DC 5 Woody riparian species are reproducing and are structurally diverse with a range of seral states present.
- FW-WSW-RMZ-FSR-DC 8 Bebb, coyote, red and Arizona willows are reproducing with a range of age classes present, where the potential for these species exists.
- FW-WSW-RMZ-FSR-DC 12 Dense willow conditions (70 percent cover or greater) are retained for at-risk species habitat.
- FW-WSW-RMZ-FSR- G 1 Connectivity within forest and shrub riparian should be maintained and enhanced by protecting ecological functions, tree density and growth, and native understory, to reduce the risk of predation and nest parasitism, and to provide habitat for at-risk and other wildlife species.
- FW-WSW-RMZ-FSR- G 3 Large mature cottonwood trees should be protected from management activities that could degrade them as suitable habitat for at-risk species. Projects occurring in these areas should incorporate restoration prescriptions, to ensure persistence of this habitat type.

The following guidelines were added within to mitigate disturbance from project management activities to all riparian associate species of conservation concern:

- FW-WSW-DC 6 Watersheds support multiple uses (e.g., timber, recreation, grazing) with no long-term decline in ecological conditions. Short-term impacts occur only when they serve to improve conditions over the life of the plan.
- FW-WSW-RMZ-WR-S 2 In wetland areas, management activities, permitted uses, and structural developments (e.g., livestock water gaps, pipelines, or other infrastructure) may only occur when necessary to move toward water, soils, and vegetation desired conditions or to protect life and property.
- FW-WSW-RMZ-FSR-G 1 Connectivity within forest and shrub riparian should be maintained and enhanced by protecting ecological functions, tree density and growth, and native understory, to reduce the risk of predation and nest parasitism, and to provide habitat for at-risk and other wildlife species.
- FW-GRZ-S 1 Livestock management shall be compatible with capacity and address ecological resources (e.g., forage, invasive plants, at-risk species, soils, riparian health, and water quality) that are departed from desired conditions, as determined by temporally and spatially appropriate data.
- FW-FFP S 2 Timber harvest shall only occur where soil, slope, and watersheds will not be irreversibly damaged, and protection must be provided for streams, streambanks, shorelines, lakes, wetlands, other waterbodies, fish, wildlife, recreation (including trails), and aesthetic resources.
- FW-REC-G 1 Recreation activities should be compatible with and managed adaptively to minimize impacts to at-risk species and ecological desired conditions, including in riparian management zones (e.g., along streams, around seeps, springs, lakes, and wetlands).

Determination: For species that use riparian and aquatic habitat, the ecosystem level plan components should provide the ecological conditions necessary to maintain persistence for most species in the plan area. However, additional species-specific components have been added to maintain persistence of Northern leopard frog, Western boreal toad, Wilson's warbler, Nokomis fritillary butterfly, and Arizona willow. The

combination of ecosystem and species-specific plan components should provide the ecological conditions necessary to maintain persistence in the plan area.

Aquatic Associates

(Streams, waterbodies, seeps/springs, riparian): Northern leopard frog, western boreal toad, Rio Grande cutthroat trout, Rio Grande chub, and Rio Grande sucker

- Key Ecological Conditions: riparian habitat, springs, and permanent and ephemeral water (natural or artificial).
- Key Threats: Loss of riparian ecological condition due to changes in water levels or diversion (altered hydrology), invasive species, predations, sedimentation from roads, and/or activities such as grazing.

Aquatic habitats include seeps and springs, perennial streams, waterbodies, wetlands, and other water features that are highly departed. Species associated with this type of habitat would benefit from plan objectives that move aquatic/riparian ecological conditions toward the desired state. The objectives, total amount of ecological condition moved toward desired conditions, and effects differ across action alternatives. The differing amounts of ecological condition improved are highlighted in the individual sections for each alternative.

Plan components that would benefit the species that depend on aquatic ecosystems can be found under the Nonnative Invasive Species, Wildlife, Fish, and Plants, Watershed, and all Water Resources sections of the action alternatives. Additional plan components that balance multiple use with wildlife needs can be found under the Sustainable Grazing and Livestock Management, Special Use, Recreation, and Roads sections.

Coarse Filter

Desired conditions for the watershed and water, riparian management zones, streams, waterbodies, springs and seeps resource sections (FW-WSW-DC 1-3; FW-WSW-RMZ-DC 1-8; FW-WSW-RMZ-STM-DC 1-10; FW-WSW-RMZ-WB-DC 1-5; FW-WSW-RMZ-SNS-DC 1-7) would move these systems toward proper functioning condition, while balancing multiple uses with ecological integrity. These components would also improve altered hydrology by minimizing water diversions and improving hydrologic function, while maintaining systems that are resilient to climate change and associated disturbances such as fire. Guideline FW-WSW-G 1 would ensure that best management practices are applied to every site-specific project that has the potential to affect the watershed conditions. Several standards and guidelines (FW-WSW-G 2; FW-WSW-RMZ-G 1-4; FW-WSW-RMZ-WR-S 1-3) would mitigate adverse effects from road construction or reconstruction (which can cause sedimentation) and would also rehabilitate in stream structures which could improve hydrologic function. Standards for sustainable forestry and forest products (FW-FFP-S 1-2) would protect the ecological integrity of watershed conditions by minimizing potentially adverse effects that could cause soil erosion and sedimentation during timber harvest operations. Plan components for the sustainable rangelands and livestock grazing resource (FW-GRZ-DC 4-6; FW-GRZ-S 1; FW-GRZ-G 1-2; FW-GRZ-G 5; FW-WSW-RMZ-STM-DC 11, FW-WSW-RMZ-WB-DC 6) would ensure associated management activities are compatible with ecological function and supportive of diverse native plant communities in wetland and riparian areas/riparian management zones that are adjacent to aquatic systems.

Desired condition FW-WSW-RMZ-STM-DC 4 would promote riparian areas from streambed and flood plain alteration while guidelines for the roads (FW-WSW-G 2; FW-WSW-RMZ-G 3; FW-TFA-G 1-4; FW-TFA-G 6) would minimize disturbance (e.g., water flow, sedimentation) from the construction of roads by including mitigations to limit disturbance in riparian zones during project-level design.

Livestock grazing can trample, alter plant community structure, species composition, relative abundance of species, vegetative density, and alter stream channel morphology for these aquatic species. Plan components for the sustainable rangelands and livestock grazing program areas (FW-GRZ-DC-4-6; FW-GRZ-S-1; FW-GRZ-G-2-3) emphasize that livestock grazing within riparian management zones must be compatible with ecological function and the needs of at-risk species, and that desired conditions for riparian vegetation and

proper stream channel morphology and floodplain function are sustained. These plan components would be beneficial by balancing multiple use with healthy riparian systems, which in turn, would provide healthy aquatic systems. Over the last decade, the Carson range staff has worked with partners and permit holders to manage grazing pressure on sensitive areas (such as critical areas and riparian areas).

Nonnative plant species can outcompete native species, causing reduction in suitable habitat and alterations in riparian function that may affect water quality, while nonnative invasive animals and pathogens can cause direct mortality and predation to aquatic species. These threats are reduced through plan components in the Nonnative Invasive Species and Wildland Fire Management resource sections of the plan through desired conditions, standards and guidelines (FW-NIS-DC 1; FW-NIS-S 1-2; FW-NIS-G 1, 3, 5-6; FW-FIRE-G 2-3) that minimize impacts to wildlife in riparian areas, aquatic habitat, and would also prevent pathogen transmission.

Fine Filter

Additional fine filter plan components were added for several at-risk species to mitigate the removal of tree-related features in riparian areas:

Several guidelines were specifically added to mitigate the specific risk from invasive species (including predation) and disease on species of conservation concern aquatic species, to ensure tree components needed by species of conservation concern, and to ensure management activities are compatible with the needs of all species of conservation concern aquatic species and that it promotes desired conditions in riparian and aquatic ecological conditions:

Desired Conditions

- FW-WSW-DC 2 Ecological components (e.g., soil, vegetation, and fauna) are resilient or adaptive to disturbances, including human activities, changes in climate patterns, and natural ecological disturbances (e.g., fire, drought, flooding, wind, grazing, insects, disease, and pathogens), and maintain or improve water quality and riparian and aquatic species habitat.
- FW-WSW-DC 3 Soils, riparian areas, and watersheds sustain groundwater quantity and quality, and recharge in aquifers. The water table is maintained at a level that sustains native riparian and aquatic vegetation, high productivity, and soil moisture characteristics.
- FW-WSW-DC 4 Aquatic habitats are connected and free from alterations (e.g., temperature regime changes, lack of adequate streamflow, constructed barriers to aquatic organism passage) to allow for species migration, connectivity of fragmented populations and genetic exchange. A constructed barrier to movement exists only to protect native aquatic species from nonnative aquatic species or for agricultural benefit (e.g., headgates).
- FW-WSW-DC 5 Aquatic and riparian habitats support self-sustaining populations of native fish, as well as other aquatic and riparian species, and provide the quantity and quality of aquatic and riparian habitat within reference conditions.
- FW-WSW-DC 6 Watersheds support multiple uses (e.g., timber, recreation, grazing) with no long-term decline in ecological conditions. Short-term impacts occur only when they serve to improve conditions over the life of the plan.
- FW-WSW-RMZ-DC 2 Riparian vegetation, particularly native species, support a wide range of vertebrate and invertebrate animal species. There is adequate recruitment and reproduction to maintain diverse native plant species composition indicative of the soil moisture conditions for the site.
- FW-WSW-RMZ-DC 3 Native obligate wetland species dominate herbaceous bank cover.
- FW-WSW-RMZ-DC 4 Riparian vegetation (density and structure) provides site-appropriate shade to regulate water temperature in streams.

- FW-WSW-RMZ-DC 5 Riparian ecosystems exhibit connectivity between and within aquatic, riparian, and upland components that reflect their natural linkages and range of variability. Stream courses and other links provide habitat and movement that maintain and disperse populations of riparian-dependent species, including beaver. Riparian areas are connected vertically between surface and subsurface flows.
- FW-WSW-RMZ-STM-DC 2 Stream ecosystems, including ephemeral watercourses, are not fragmented by infrastructure or development, except when the fragmentation serves to protect native aquatic species from nonnative aquatic species. Streams provide connectivity important for dispersal, access to new habitats, perpetuation of genetic diversity, as well as nesting and foraging for at-risk species.
- FW-WSW-RMZ-STM-DC 3 Aquatic species are able to move throughout their historic habitat including opportunities for seasonal and opportunistic movements. Barriers to movement only exist to protect native aquatic species from nonnative aquatic species or for agricultural benefit (e.g., headgates).
- FW-WSW-RMZ-STM-DC 6 The quantity and timing of stream flows are sustained at levels that maintain or enhance essential ecological functions, including channel and floodplain morphology, groundwater recharge, water quality, and stream temperature regulation.
- FW-WSW-RMZ-STM-DC 9 Habitat conditions, as described in stream desired conditions, are capable of supporting self-sustaining native aquatic species populations. These habitat conditions include stream characteristics (i.e., riffles, runs, pools, and channel meandering) that allow for natural processes to occur (e.g., floodplain connectivity and sediment transport). Quality aquatic habitat is provided by overhanging banks, woody and herbaceous overstory, and instream large woody debris, to regulate stream temperatures, maintain soil moisture, and provide cover for riparian species along streams.
- FW-WFP-DC 3 Ecological conditions (Vegetation and Watersheds and Water desired conditions) provide habitat that contribute to the survival, recovery, and delisting of species under the Endangered Species Act; preclude the need for listing new species; improve conditions for species of conservation concern; and sustain both common and uncommon native species.
- FW-WFP-DC 4 Habitat conditions (Vegetation and Watersheds and Water desired conditions) provide the resiliency and redundancy necessary to maintain species diversity and metapopulations.
- FW-WFP-DC 10 All aquatic and riparian habitats are hydrologically functioning and have sufficient emergent vegetation as described in Watersheds and Water desired conditions or site potential, as well as macroinvertebrate populations to support resident and migratory species.
- FW-GRZ- DC 4 Livestock grazing and associated management activities are compatible with ecological function and process (e.g., water infiltration, wildlife habitat, soil stability, and natural fire regimes).
- FW-FIRE-DC 8 Post-fire restoration and recovery should be provided where critical resource concerns merit rehabilitation for controlling the spread of invasive species, protecting areas of cultural concern, protecting critical or endangered species habitat, or protecting other highly valued resources.

Standards

- FW-WSW-RMZ-STM-S1, WB-S 1, SNS-S1 Management activities in and around streams shall use decontamination procedures to prevent the spread of non-desirable fungus, disease, nonnative and invasive biota.
- FW-FPP- S 2 Timber harvest shall only occur where soil, slope, and watersheds will not be irreversibly damaged, and protection must be provided for streams, streambanks, shorelines, lakes, wetlands, other waterbodies, fish, wildlife, recreation (including trails), and aesthetic resources.

Guidelines

- FW-WSW-RMZ-STM-G 3 Streambed should contain less than 20 percent fines (sand, silt, clay) in riffle habitat, to maintain fish spawning.

- FW-WSW-RMZ-STM-G-5 In-stream management activities that have the potential to directly deliver sediment to at-risk species' core habitats should be limited to times outside of spawning and incubation seasons for those species to protect spawning fish, eggs, and embryos.
- FW-FAC-G 2 Facilities and structures should be designed and maintained to prevent or mitigate impacts to terrestrial and aquatic species (e.g., bear-proof dumpsters, capped pipe used for fences, survey markers, and signposts, or wildlife egress in plumbing vents).
- FW-WFP-G 6 To conserve wildlife and fish habitat connectivity, constructed features (e.g., exclosures, wildlife drinkers, range improvements, fences, and culverts) should be maintained to support the purpose(s) for which they were built. Constructed features should be removed when no longer needed, to restore natural hydrologic function and maintain habitat connectivity.

Management Approaches

- Coordinate with the New Mexico Department of Game and Fish (NMDGF), USFWS, adjacent Federal and State land managers, and federally recognized tribes regarding listed and native species; reintroductions, introductions, or transplants and habitat improvements of listed or native species; control or eradication of nonnative species; and the management of sport and native fishes, including the identification of refugia for native fish.
- Cooperate with State and Federal wildlife management agencies, to minimize conflicting wildlife resource issues related to hunted, fished, and trapped species.
- Coordinate with the NMDGF, USFWS, sportsman's groups, the scientific community, and other stakeholders regarding information, education, and knowledge gaps as they relate to promoting and improving wildlife, fish, and plant resources and management.
- Consider coordinating with the New Mexico Department of Game and Fish, so that management activities are consistent with the agency's fisheries management plans.

Determination: For species that use riparian and aquatic habitat, the ecosystem level plan components should provide the ecological conditions necessary to maintain persistence for most species in the plan area. However, additional species-specific components have been added to maintain persistence of aquatic species of conservation concern. The combination of ecosystem and species-specific plan components should provide the ecological conditions necessary to maintain persistence in the plan area.

Cliff, Caves, Mines, Rocky Features Associates

American peregrine falcon, pale Townsend's big eared bat, spotted bat, alpine larkspur, Chaco milkvetch, Chama blazing star, small-headed goldenweed, tufted sand verbena are cliff, caves, mines, rocky features associates

- Key ecological conditions: rocky habitats which provide roosting or nest sites and adequate escape terrain.
- Key threats: loss or disturbance of roosting/nesting sites, disease (e.g., White Nose Syndrome), direct damage to plant.

Coarse-filter

Persistence for species that utilize caves, mines, rocky features and cliff ecological condition is largely realized through the Caves and Abandoned Mines, Cliffs and Rocky Features, Minerals and Mining, and Recreation sections. Desired conditions and guidelines ensure mining activities will be compatible with ecosystem health and wildlife ecological condition needs, especially bats, (FW-MM-DC 1-2; FW-WFP-G 7; FW-CRF-G1) and guideline (FW-CAM-G 1) that mine and cave closures are designed to accommodate historically occurring wildlife. In addition, desired conditions and guidelines for caves (FW-CAM-DC 1-3; FW-CAM-G 3) promote biologic integrity and protection from damage and alteration.

Desired conditions for cliffs and rocky features (FW-VEG-DC 17-19; FW-VEG-PPF-DC 19; FW-VEG-PJO-DC 14; FW-VEG-PJS-DC 16; FW-SL-DC 7; FW-CRF-DC 1-3; DA-BOT-DC 1-2) would promote ecological conditions to support plant and animal species of conservation concern that use these habitat features. Finally, desired conditions and guidelines for Vegetation Cliffs and Rocky Features, and Wildlife, Fish, and Plants would also protect non-vegetative habitat components from disturbance (FW-VEG-DC 13; FW-VEG-G 3; FW-CRF-G 1; FW-WFP-G 3).

Fine-filter

Desired conditions and guidelines were specifically added for some at-risk species to mitigate disturbance from recreational rock climbing, provide protections from trampling of plants, protection to other species during the breeding season and at maternity roosts, and to minimize the spread of disease. The following plan components would especially benefit bats, plants, and peregrine falcon by mitigating these threats.

Standard

- FW-VEG-S 1 Collection of plant at-risk species shall be for research or scientific purposes only.

Guidelines

- FW-VEG-G 3 Vegetation should provide for at-risk species' habitats, by minimizing disturbance, providing recovery strategies, and managing for desired levels of key structural elements (e.g., large old trees and snags, downed woody debris, denser vegetation structure, and soil structure) important for nesting, rearing, breeding, foraging, dispersal, and other life history needs, to maintain the persistence or contribute to the recovery of at-risk species.
- FW-VEG-ALP-G 1 Trail construction and maintenance in ALP should avoid minimize disturbance to at-risk plants and to important key habitat features (e.g., rock outcrops, willows, and talus slopes) for at-risk species and other alpine dependent species (e.g., yellow-bellied marmot and American pika), to maintain the persistence of native species.
- FW-VEG-CAM-G 1 Caves or abandoned mines that are to be closed should use the most currently recommended closure devices, to allow for the continued use of any species determined to be present in the cave or abandoned mine.
- FW-VEG-CAM-G 2 The most current Forest Service guidance or most recent decontamination procedures should be used in caves and abandoned mines to avoid spread of white-nose syndrome (*Geomyces destructans* fungus).
- FW-CRF-G 2 Rock climbing and related recreation activities should not disrupt the life processes of cliff or rocky feature dependent at-risk species (e.g., American peregrine falcon, spotted bat, and small-headed goldenweed), diminish the function of specialized vegetation (e.g., mosses, lichens, and small headed goldenweed), to maintain the persistence or contribute to the recovery of at-risk species.
- FW-CRF-G 4 Where recreation or other management activities have the potential to trample known populations of at-risk plant species, signs should be posted educating the public to stay on designated trails, to maintain the persistence or contribute to the recovery of at-risk species.
- FW-WFP-G 3 Management activities should avoid disturbance at known active raptor nests and fledging areas, to maintain the persistence or contribute to the recovery of at-risk species. Timing restrictions, adaptive percent utilizations, distance buffers, or other means of avoiding disturbance should be based on the best available scientific information, as well as on site-specific factors (e.g., topography and available habitat).
- FW-WFP-G 7 Where known bat use and concentrations of bats occur (e.g., maternity colonies, hibernacula, or seasonal roosts), measures to maintain habitat and reduce disturbance by human activities through use of seasonal or permanent access restrictions should be used. These habitats generally include abandoned mines, caves, bridges, rock crevasses, old buildings, or tree snags.

- FW-REC-G 1 Recreation activities should be compatible with and managed adaptively to minimize impacts to at-risk species and ecological desired conditions, including in riparian management zones (e.g., along streams, around seeps, springs, lakes, and wetlands).
- FW-TFA-G 5 Bridges and other structures determined to be important habitat for at-risk wildlife (birds, bats, etc.) should be retained unless demolition is necessary to ensure public safety.
- FW-TFA-G 6 Road construction and maintenance activities should avoid or minimize habitat disturbance of known at-risk species, to maintain the persistence of at-risk species.
- FW-TFA-G 10 Where recreation or other management activities have the potential to trample known populations of at-risk plant species, signs should be posted educating the public to stay on designated trails and avoid impacts.

Management Approaches for Caves and Abandoned Mines resource sections:

1. Currently, neither the cause nor the transmission of white-nose syndrome is well understood; however, it is known that a cave or abandoned mine environment containing this fungus is infectious to hibernating bats. Consider the development of a response plan for white-nose syndrome through continued collaboration with the U.S. Fish and Wildlife Service (USFWS), Bat Conservation International, New Mexico Department of Game and Fish, the National Speleological Society, and others with interests in conservation management for bat species.
2. Consider working with public affairs, recreation, invasive species, minerals staffs; State and other Federal agency partners; and the public to internally and externally increase white-nose syndrome awareness at local and regional levels.

Management Approaches for Cliffs and Rocky Features resource section:

1. Consider additional survey efforts, targeted monitoring, and research on life history and habitat needs, to fill information gaps on the rare and narrow endemic species that use cliffs and rocky features.
2. Consider working with public affairs, recreation, invasive species, and minerals staffs; State and other Federal agency partners; and the public to internally and externally increase the awareness and valuation of these features, especially for threatened, endangered, and species of conservation concern (e.g., small-headed goldenweed and peregrine falcon).
3. Consider partnering with volunteers, rock climbing organizations, other government agencies, cooperators, and permit holders to help co-manage sustainable rock climbing opportunities, including planning, design, implementation, operations, and maintenance of rock climbing areas.

Determination: For all species that use Cliff, Caves, Mines, and Rocky Features, the ecosystem-level plan components may not provide the ecological conditions necessary to maintain persistence for most species in the plan area. Therefore, additional species-specific plan components have been provided. The combination of ecosystem- and species-specific plan components should provide the ecological conditions necessary to maintain persistence in the plan area for American peregrine falcon, pale Townsend's big eared bat, spotted bat, alpine larkspur, Chaco milkvetch, Chama blazing star, small-headed goldenweed, and tufted sand verbenas.

Multiple vegetation communities

Some species like American peregrine falcon, masked shrew, and spotted bat use a variety of ecological conditions. Key ecological conditions for the falcon and spotted bat were addressed above under Cliffs and Rocky Features. For the masked shrew, the key ecological conditions include coarse woody debris and mesic high-elevation habitat. These needs would be provided for largely through plan components under Terrestrial Species Habitats.

Environmental Consequences for Species of Conservation Concern – Alternatives 2 and 5

Alternatives 2 and 5 retain relevant plan direction from alternative 1 but are more responsive to current science and thinking, while addressing the core themes and significant issues explored during the plan revision process. The only difference between alternatives 2 and 5 is the amount of recommended wilderness, which was discussed in the effects common to all action alternatives. The primary difference between alternatives 2 and 5 and the other alternatives is the addition of three place based Management Areas with their own plan components, variation among management objectives and restoration, and objectives for road management. All other plan components would remain the same as those listed under all action alternatives. In addition to the environmental consequences for all alternatives described earlier, alternatives 2 and 5 would primarily differ from alternative 1 in the rate and magnitude of ecological condition restored for riparian dependent species and species affected by frequent-fire adapted ecosystem treatment.

Frequent Fire Forest vegetation community is moderately to highly departed and trending away from reference conditions ([Ecological Conditions](#)). Alternatives 2 and 5 would increase the current rate of mechanical treatment (27,500 to 60,000 acres during each 10-year period) and the current rate of wildland fire (100,000 to 165,000 acres during each 10-year period).

After 15 years, desired conditions for mixed conifer would remain moderately departed but would move closer to the desired state, changing from departure of 64 percent to 43 percent. While ponderosa pine forest would remain highly departed, but would move closer to the desired state, changing from 92 percent to 59 percent. This would be an improvement in ecological condition over alternative 1 for species that depend on frequent fire-adapted ecosystems.

Watershed resources, riparian, and aquatic habitats are highly departed and are trending away from reference conditions. Alternatives 2 and 5 set objectives to restore structure and function of at least 200 to 300 acres of riparian areas annually, and objectives to restore, enhance, or maintain 100 to 150 stream miles, and 10 to 20 springs during each 10-year period. This also includes objectives (FW-TFA-O 1-3) and guidelines (FW-TFA-G 2 and 7) to maintain or decommission roads to improve watershed health. Alternatives 2 and 5 also set objectives and include plan components (FW-WSW-DC 4-5; FW-WSW-RMZ-DC 2; FW-WSW-RMZ-STM-DC 2-3, 9; FW-WFP-DC 1-4; FW-WFP-O 3-5) to maintain or restore the distribution of native aquatic species of conservation concern, especially Rio Grande chub, Rio Grande cutthroat trout, and Rio Grande sucker. Treatments may occur anywhere on the Carson where they are determined to be appropriate. These plan components would move riparian and aquatic ecological condition across the forest closer to a desired state and would increase native aquatic species distribution. Moving toward desired conditions would improve ecological conditions necessary to maintain persistence for riparian and aquatic species of conservation concern by decreasing sedimentation and improving seral state distribution, surface flow timing and duration, and repairing disconnected floodplains. Improving native aquatic species distribution by improving ecological condition, improving habitat connectivity, and removing nonnative species competition, in coordination with New Mexico Department of Game and Fish, would increase persistence of aquatic species of conservation concern across the forest. Also see riparian associates and aquatic associates under environmental consequences common to all alternatives for more riparian species discussion.

Under alternatives 2 and 5, increased levels of mechanical and restoration treatments from objectives would cause increased temporary ground disturbance to frequent fire forest and riparian-dependent species of conservation concern. However, within these alternatives, plan components specifically addressing soil and ground disturbance are found throughout all sections of the plan (FW-VEG-G 2, FW-SOIL-G-1 and 2, FW-WSW-DC 2, FW-GRZ-G 4-5, FW-TFA-G 1-2, FW-TFA-G 9, FW-REC-G 1, FW-FFP-S 2, FW-FFP-G-3, and FW-SU-G-1-3). There are also plan components and objectives (FW-TFA-O 1, FW-TFA-G 3 and 4, and FW-REC-O 6) within this alternative that seek to rehabilitate areas that are disturbed. The entire suite of plan components addressing this threat can be found in appendix H.

The primary plan components in management areas, which could impact species diversity, and that differ from alternatives 3 and 4 include desired conditions and guidelines for Grassland Maintenance Management

Area (all ranger districts), Valle Vidal Management Area (Questa Ranger District), and San Antonio Management Area (Tres Piedras Ranger District). Grassland Maintenance Management Area (MA-GMMA-DC 1) preserves woodlands and ponderosa pine forest in a treeless state to promote forage production. Areas within this management area have been preserved in a treeless state for over 50 years and have not been available for woodland-dependent species of conservation concern use during this time. Under alternatives 2 and 5, there are 396,522 acres of woodland ecological condition that would be improved and would thereby maintain the ability of species of conservation concern to persist within woodland vegetation. This management area would increase grassland ecological condition for grassland-dependent species of conservation concern such as burrowing owl and Gunnison prairie dog. The following Grassland Maintenance Management Area plan components would help maintain grassland-dependent species of conservation concern persistence:

- MA-GMMA-DC 2 Regeneration, seed head production, and a balance of grass and forb species, including warm and cool season species, occur in most years and within the capability of soils.
- MA-GMMA-DC 3 Soil function is sustained. Soils are permeable and capable of infiltrating water to reduce overland flows during precipitation events and allow for burrowing by small mammals (Gunnison's prairie dog and masked shrew). Adequate water infiltration discourages arroyos, gullies, and head cuts from forming in drainages. Existing arroyos and gullies are stabilizing and recovering.

Valle Vidal Management Area (MA-VVMA-DC 1, 2, 4, and 5) and San Antonio Management Area (MA-SAMA-DC 1, 3-4) are managed for multiple uses, focusing on the restoration and protection of diverse, resilient, biological communities for future generations, while providing a quality backcountry outdoor recreation experience. Valle Vidal and San Antonio Management Areas limit development and road construction. Existing closed and non-system roads would continue to naturalize and would diminish watershed and ecological condition impacts from sedimentation and habitat segmentation. Ecological condition improvement from limiting development and road construction would improve the ability for species of conservation concern found within these management areas to persist. All plan components within these management areas would provide for species of conservation concern persistence.

Environmental Consequences for Species of Conservation Concern – Alternative 3

The primary difference between alternative 3 and the other alternatives is the addition of two place-based management areas (Grassland Maintenance Management Area and Off-Highway Vehicle Management Area) with their own unique plan components, and the expansion of the Developed Winter And Summer Resort Management Area boundary. The San Antonio and Valle Vidal Management Areas found in alternatives 2, 4, and 5 are not included in this alternative. Alternative 3 uses mechanical treatment, wildfire, and fuelwood collection to decrease risk from stand-replacing wildfire and to improve ecosystem function. All other plan components would remain the same as those listed under all action alternatives.

Alternative 3 has higher mechanical treatment objective acres than any other alternative for fire-adapted ecosystems, and sustainability of springs, wetlands, and riparian areas (improved watershed health). An increased emphasis on restoration intensity emphasizes partnerships to get more work done on the ground to achieve desired conditions at greater rate than the other alternatives. This should benefit most species that depend on fire-adapted and riparian ecosystems by improving ecological condition at a faster rate and intensity in areas that need it most.

Using mechanical treatments with frequent fire forest there would be an increase to 65,000 to 130,000 acres treated during each 10-year period. Acres treated using prescribed fire would remain the same as alternatives 2 and 5 (100,000 to 165,000 acres during each 10-year period). Under alternative 3, in 15 years, desired conditions for Mixed Conifer would remain moderately departed but would move closer to the desired state, changing from of departure of 64 percent to 33 percent. Ponderosa pine would become moderately departed (41 percent) an improvement from current conditions (92 percent departure). For species that depend on fire-adapted ecosystems, this alternative would realize the greatest overall improvement in ecological condition. However, widespread mechanical treatment under alternative 3 would result in the most ground disturbance

and associated effects to understory vegetation. Localized, short-term impacts to soil stability and erodibility, with subsequent watershed impacts such as increased sedimentation, would be more likely. There may be higher probability of localized invasive species distribution and establishment in disturbed areas. Increased sedimentation, increased ground disturbance, and increases in invasive species distribution would negatively impact species of conservation concern and their persistence.

This alternative places more emphasis on human uses, therefore road maintenance is emphasized with the potential to increase road use. Temporary roads would be considered for inclusion into the system to support multiple use activities and access to the forest as an alternative to decommissioning. In addition, this alternative proposes an off-highway vehicle management area on the Camino Real Ranger District. The Off-Highway Vehicle Management Area would allow cross-country travel opportunities within the management area to provide challenging terrain for trials motorcycles and off-highway vehicle rock crawling. The added footprints of increased road activity and the proposed Off-Highway Vehicle Management Area would increase ground and soil disturbance and would increase intrusive human activities (vehicle noise) that would negatively impact species of conservation concern. More resources may be diverted toward recreation, meaning less focus on habitat improvement projects.

Grassland Maintenance Management Area (forestwide) is also proposed under this alternative, and effects from plan components for Grassland Maintenance Management Area would be the same as described for alternatives 2 and 5.

The Developed Winter and Summer Resort Management Areas comprises the permitted ski areas on the Carson. This management area is currently managed in an altered vegetative state from reference condition and would continue to be managed as such under alternative 3. However, under this alternative the Developed Winter and Summer Resort Management Area would be expanded by 921 acres around the Sipapu Ski and Summer Resort. The current Sipapu permitted boundary is 215 acres and would not change under any alternatives except alternative 3, where it would likely be expanded through a separate analysis. Expansion of this boundary would alter current vegetation from a forested to a grassland state, thereby possibly decreasing frequent fire forest ecological conditions, decreasing habitat connectivity, and would possibly increase ground disturbance and human intrusive disturbance from ski area development within the expanded part of this management area for frequent fire forest species of conservation concern. However, the expansion of this management area would increase habitat for non-forested species of conservation concern such as masked shrew. Effects from this management area are analyzed under environmental consequences common to all alternatives.

This alternative, with increased mechanical treatment, would move departed ecological conditions of frequent fire forest toward desired condition the fastest. However, the increased mechanical treatment, potential to increase road use, the inclusion of Off-Highway Vehicle Management Area, and the expansion of Developed Winter and Summer Resort Management Area would have the greatest increase in ground disturbance and human instructive disturbance. Watershed conditions would be worse compared to alternative 2, with cascading impacts on riparian function, thereby negatively impacting riparian and aquatic species of conservation concern.

Environmental Consequences for Species of Conservation Concern – Alternative 4

The primary difference between alternative 4 and the other alternatives is the greater use of naturally ignited wildfires and prescribed fires to achieve restoration objectives (125,000 to 25,000 acres during each 10-year period) under alternative 4. Mechanical treatment would focus on treating fuels to protect communities instead of forestwide restoration. Alternative 4 also includes four placed-based management areas that would have their own plan components. Otherwise, forestwide plan components would be the same as described previously under environmental consequences for all action alternatives. Under alternative 4, unplanned ignitions would be encouraged to play their natural role in ecosystems at the landscape level more than other alternatives. Current understanding of fire and its use has evolved over the last 50 years and the scientific community now recognizes the beneficial effects lower-intensity wildfire may have on forest structure and

wildlife ecological condition (C. Miller and Aplet 2016). A caveat to this would be high-intensity, landscape-scale fires that would be detrimental to wildlife species that use frequent fire-adapted systems.

After 15 years, desired conditions for mixed conifer with frequent fire would remain moderately departed but would move closer to the desired state, changing from a departure of 64 percent to 44 percent. Ponderosa pine forest would remain highly departed (71 percent), a moderate improvement from current conditions (92 percent departure). For species of conservation concern that depend on frequent fire adapted ecosystems, this alternative would be similar to alternative 2 in terms of overall ecological condition improved for these two vegetation types. However, the decrease of mechanical treatment could also put these species at greater risk for reductions of foraging, nesting, and roosting habitat resulting from uncharacteristic, stand-replacing wildfire.

Proposed management areas included under alternative 4 are Wetland Jewels Management Area (forestwide), Valle Vidal Management Area (Questa Ranger District), San Antonio Management Area (Tres Piedras Ranger District), and Rio Grande Cutthroat Trout Management Area (forestwide). Effects from these management areas to species of conservation concern are described in more detail below.

Alternative 4 limits motorized access through several means, including stricter guidance regarding the creation of new permanent or temporary roads (FW-TFA-S 3-4), obliterating or naturalizing double the number of miles of non-system roads (FW-TFA-O 1), expanding the San Antonio Management Area and requiring seasonal closures (MA-SAMA-S 8-9), prohibiting new motorized trails within Valle Vidal and San Antonio Management Areas (MA-VVMA-S- 24, MA-SAMA-S-12), and prohibiting new permanent roads or motorized trails in the Wetland Jewels Management Area (MA-WJMA-S-1). Direct riparian impacts such as sedimentation and vegetation removal would be slightly reduced overall. Invasive species spread would be slowed somewhat related to reduced access by motorized vectors, but treatment to restore riparian function may also be made more difficult in some locations. Decreases in ground disturbance, intrusive human activity, sedimentation, and distribution of invasive species would beneficially impact species of conservation concern.

Valle Vidal and San Antonio Management Areas would have similar effects as discussed for alternatives 2 and 5, with the exception of the above discussion on limiting motorized access. Grassland Maintenance Management Area is not proposed under this alternative; therefore, these areas would revert back to woodlands or ponderosa pine forest under this alternative. Woodland and ponderosa pine dependent species of conservation concern would have more acres available under this alternative, but grassland ecological conditions would decrease for grassland-dependent species of conservation concern.

Wetland Jewels Management Area would focus road obliteration and riparian restoration work in these areas rather than in priority watersheds, which is where riparian restoration activities are focused in all other action alternatives. The efficacy or feasibility of treating these areas is not clearly greater than they are for treating other locations on the forest. In fact, treatment return on investment is likely to be low, since 49 percent of the Wetland Jewels Management Area is in either designated wilderness, recommended wilderness, or inventoried roadless areas, each of which restricts management options compared to other forest areas. For example, earth work or moving boulders by hand is more costly, time consuming, and labor intensive than doing the same work with machinery. Wetland Jewels Management Area should benefit aquatic and riparian species of conservation concern species within this management area, but emphasis on aquatic and riparian restoration within this management area would improve forestwide ecological conditions for riparian and aquatic vegetation communities at a slower rate and intensity than other action alternatives.

Rio Grande Cutthroat Trout Management Area would focus native aquatic species restoration work in these areas, rather than forestwide or at the discretion of the New Mexico Department of Game and Fish. Treatments to remove nonnative species (MA-RGCTMA-O 1) and desired condition that improves connectivity and ecological condition within the Rio Grande Cutthroat Trout Management Area (MA-RGCTMA-DC 1) would increase native aquatic species distribution within this management area.

This alternative would also have the highest negative impact from uncharacteristic stand-replacing wildfire.

Summary of All Alternatives for Species of Conservation Concern

All alternatives would maintain persistence for species of conservation concern (within the authority of the Forest Service), however, the rate and magnitude of change to wildlife ecological condition varies by alternative.

Alternative 1 is limited in terms of its ability to positively affect species persistence, because it lacks clear desired conditions and guidelines developed using the best available science. It does not reflect the most current advances in scientific understanding and changes in social, economic and ecological conditions that have occurred since it was signed, and it is the least able to adapt to changing conditions. Alternative 1 also lacks forestwide language that directly addresses the significant threats of disease and invasive, nonnative animals; connectivity; altered hydrology; and restricted and endemic species that are naturally rare. Plan components for species of conservation concern were not developed using the coarse-filter/fine-filter process. Overall, this alternative would realize the least amount of restoration progress for the most wildlife species compared to action alternatives. At best, species persistence would be maintained but ecosystem recovery would be on a slower trajectory than for the action alternatives for most species.

Alternative 3 focuses on forest products and increased human use. This alternative has more clearly defined plan components than alternative 1 to better address wildlife species needs at multiple spatial scales. Under this alternative species are generally protected through specific vegetation community, Watershed, and Management Area direction, however, in some cases there is additional species-specific direction that provides even more emphasis and protection for species of conservation concern. Alternative 3 was specifically developed using a coarse-fine filter process. Alternative 3 has the greatest ability for maintaining species persistence over time (for the majority of species). This alternative, with increased mechanical treatment, would move departed ecological condition of frequent fire forest toward desired condition the fastest. However, increased mechanical treatment, potential to increase road use, and inclusion of Off-Highway Vehicle Management Area would have the greatest increase in ground disturbance. Watershed conditions would be worse compared to alternative 2, with cascading impacts on riparian function, thereby negatively impacting riparian and aquatic species of conservation concern.

Alternatives 2 and 4 would move ecological condition toward the desired conditions faster than alternative 1. However, alternative 4 would move riparian and aquatic ecological conditions toward the desired condition at a slower rate than alternatives 2 or 3, because restoration overall would be slightly less effective. Alternative 4 would also have the highest negative impact from uncharacteristic, stand-replacing wildfire. Both alternatives would include the same forestwide plan components for species of conservation concern as alternative 3.

Alternatives 4 and 5 recommend more new wilderness than alternatives 2 and 3, which would benefit some species in the short term. However, the forest would be limited to naturally ignited wildfire managed for resource benefits in these areas. As a result, the net positive impacts from these additions on wildlife would be counterbalanced by the potentially negative effects that could result from large, stand-replacing wildfire.

Regional Forester's Sensitive Species

The regional forester's sensitive species program is the Forest Service's dedicated initiative to conserve and recover plant and animal species according to Forest Service policy (FSM 2670). The Carson improves habitat and restore ecosystems for sensitive species through vegetation treatments and management practices. Sensitive species are those plant and animal species identified by a regional forester for which population viability is a concern, as evidenced by the following:

- Significant current or predicted downward trends in population numbers or density

- Significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution.

There are 31 sensitive species known to occur on the Carson spread across all six ranger districts. Sensitive species are associated with nine distinct vegetation communities as well as aquatic habitat, caves, and rocky features.

Table 43 shows the districts where each species is known to occur, the amount of habitat potentially available by vegetation community, and the amount of habitat occupied (if known) for each species. Occupied habitat is a subset of the total acreage for each vegetation community. Information in the table is derived from the Ecological Assessment (USDA FS Carson NF 2015a), Carson National Forest Geographic Information System (GIS) files, the Natural Resource Manager (NRM) system, which is the database of record for Forest Service, and the Vegetation Dynamics Development Tool model runs from the vegetation analysis.

Environmental Consequences for Regional Forester's Sensitive Species

Environmental Consequences for Regional Forester's Sensitive Species Common to All Alternatives

Effects of probable management activities that could potentially affect wildlife communities can be grouped into three broad categories: (1) changes in the type, quantity, quality, and spatial arrangement of suitable habitat; (2) direct mortality, reduced survival, or increased susceptibility to mortality; and, (3) increased disturbance.

For each species or group of species, the plan considers the extent that ecosystem-level plan components provide for ecosystem integrity and diversity to meet the ecological conditions necessary for those species within their range. Species-specific plan components were added as needed. Appendix H lists the forestwide plan components that would apply to sensitive species under all action alternatives. The action alternatives have additional place-based plan components or objectives which are described in their individual sections. The following analysis applies to shared plan components.

Ecological conditions

All five alternatives would use mechanical vegetation treatment and wildfire to manage frequent fire forest (e.g., mixed conifer frequent fire and ponderosa pine) and mechanical vegetation treatment or structural improvement to manage riparian/water resources (e.g., aquatics, forested riparian) to improve ecological condition, abundance, and distribution for species that depend on those vegetation communities. These systems are all highly departed from reference conditions. Current science demonstrates the positive benefits that forest fuel-reduction treatments can have in terms of improving resiliency in frequent fire-adapted systems of the west/southwest (Stephens et al. 2012). Conditions and trends in the other vegetation communities did not raise significant concerns, therefore no objectives were developed for them. The Carson has, however, identified desired conditions for these other vegetation communities and would implement management to make progress toward desired conditions as capacity allows.

For species that use frequent fire forests (dry mixed conifer and ponderosa pine), riparian (wetlands and forested riparian), and aquatic systems, like the American peregrine falcon, northern goshawk, bald eagle, pale Townsend's big-eared bat, spotted bat, northern leopard frog, western boreal toad, masked shrew, water shrew, Arizona willow, Rio Grande Chub, Rio Grande cutthroat trout, and Rio Grande sucker, the primary contemporary threat is loss of habitat related to large stand-replacing wildfire, associated run off and sedimentation that could affect riparian habitat, and reduced in-stream flow. All alternatives would move ecological condition for these species toward the desired state, but would vary in magnitude, intensity, and location of treatments through objectives. These differences are discussed by alternative. There could be some localized adverse impacts to these species, but overall, species viability would be maintained. Beneficial impacts include a slight improvement in potentially suitable ecological condition in frequent fire forests, Riparian, and Aquatic systems by increasing the amount of habitat in the desired seral states or

properly functioning condition for breeding, roosting, and foraging. Objectives to treat acres in departed systems would move those systems toward a vegetative or aquatic state more complementary to those species' evolution, especially goshawk.

On the Kaibab National forest in Arizona, Reynolds et al. (2017) assessed the effects of mixed fire severity on goshawk productivity in the Warm Fire footprint, a 91-square-mile fire that burned in ponderosa pine and mixed-conifer forests. Their study demonstrated active forest restoration is necessary to avoid more pronounced and widespread degradation or loss of habitat. The focus of their study was to assess how low and high fire severity affected nest survival and productivity. They assessed post-fire activity at 20 territories in areas of high and low fire severity and found that territories that lost more than 75 percent of the forest to moderate and high-severity fire were not reoccupied, while territories that lost between 50 to 75 percent of the forest to moderate and high severity had only 43 percent reoccupation following the fire. Post-fire occupancy of a nest area in a burned territory depended on the availability of at least one alternate nest stand in the territory that had escaped high-severity fire. Their study demonstrates management strategies for mixed fire. Ray and others (2014) found that forest treatments composed of thinning and prescribed fire in ponderosa pine forest had relatively minor effects on goshawk occupancy compared to stand-replacing fire that had occurred in the same area.

Eligible wild and scenic rivers

A comprehensive evaluation of wild and scenic rivers was conducted as part of the plan revision process, which resulted in 51 eligible wild and scenic river segments on the forest. This would have potentially beneficial impacts by limiting the types of instream infrastructure. Limiting the types of instream infrastructure would provide habitat connectivity and minimizing ground disturbance on wildlife, plant, and aquatic species that use riparian habitat and aquatic species.

Designated wilderness and inventoried roadless areas

Designated wilderness (129,119 acres) and inventoried roadless (105,000 acres) areas provide beneficial impact for habitat connectivity and minimize disturbance to species of conservation concern through primitive management or lack of road construction.

Developed Winter and Summer Resort Management Area

The Developed Winter and Summer Resort Management Area comprises the permitted ski areas on the Carson. Under the 1986 Forest Plan, as amended, this management area is currently in an altered vegetative state from reference condition and would continue to be managed as such under all alternatives. This management area could possibly decrease habitat connectivity within its boundaries for frequent fire forest sensitive species such as northern goshawk. However, this management area would improve grassland habitat connectivity for masked shrew and other grassland wildlife dependent species. This management area would also increase ground disturbance from ski area development and increase human intrusive disturbance to these species under all alternatives. The substantive difference among alternatives for Developed Winter and Summer Resort Management Area is under alternative 3, the management area is expanded by 921 acres around the Sipapu Ski and Summer Resort. The current Sipapu permitted boundary is 215 acres and would remain this acreage under all alternatives except alternative 3 where it would likely be expanded through a separate analysis. The effect of this change is discussed in Environmental Consequences – Alternative 3.

Table 43. Sensitive species, ranger district(s) they occur on, and amount of habitat occupied if known

Species	District	Vegetation Systems	Vegetation Community or Habitat Feature	Acres or Amount of Occupied Habitat	Potentially Suitable Habitat in each Vegetation Community or Number of Features Forestwide
Northern leopard frog	All	Riparian, Aquatic	Wetland Riparian, Streams, Waterbodies	Unknown	36,366 acres, 1,565 waterbodies
Western boreal toad	Canjilon, Tres Piedras	Riparian, Aquatic	Canjilon, Trout, and Lagunitas Lakes	54 acres	54 acres
American peregrine falcon	All	Non-forested, High Elevation Forest, Frequent Fire Forest, Woodlands, Riparian, Cliffs and Rocky Features, Aquatic	Alpine and Tundra, Montane Subalpine Grassland, Sagebrush, Spruce-Fir Forest, Mixed Conifer with Aspen, Mixed Conifer with Frequent Fire, Ponderosa Pine Forest, Piñon-Juniper Woodland, Piñon-Juniper Sagebrush, Riparian, Cliffs and Rocky Features, Waterbodies	Unknown	485,809 acres, Unknown amount of Cliff features
Boreal owl	All Districts except Jicarilla	High Elevation Forest	Spruce-Fir Forest	6,011 acres	144,411 acres
Bald eagle	All	Riparian, Aquatic, Frequent Fire Forest	Forest and Shrub Riparian, Waterbodies, Mixed Conifer with Frequent Fire, Ponderosa Pine Forest	Summer Range – None, Winter Range- Unknown	Summer Range – None, Winter Range- 53,549 acres
Gray vireo	Jicarilla	Woodlands	Piñon-Juniper Woodland, Piñon-Juniper Sagebrush	Unknown	75,921 acres
Northern goshawk	All	High Elevation Forest, Frequent Fire Forest	Mixed Conifer with Frequent Fire, Mixed Conifer with Aspen, Ponderosa Pine Forest, Spruce-Fir Forest	10,974 (post-fledging family areas)	93,425 acres, 46,276 acres nesting, roosting, post fledging.
Western burrowing owl	All	Non-forested	Montane Subalpine Grassland, Sagebrush	Unknown	184,495 acres, Unknown amount of Prairie dog colonies
White-tailed ptarmigan	Camino Real, Questa	Non-forested	Alpine and Tundra	Unknown	4,998 acres
Rio Grande chub	All Districts except Jicarilla	Aquatic	Streams, Waterbodies	73 miles	1,044 stream miles
Rio Grande cutthroat trout	All Districts except Jicarilla	Aquatic	Streams, Waterbodies	136 miles	1,044 stream miles

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Species	District	Vegetation Systems	Vegetation Community or Habitat Feature	Acres or Amount of Occupied Habitat	Potentially Suitable Habitat in each Vegetation Community or Number of Features Forestwide
Rio Grande sucker	All Districts except Jicarilla	Aquatic	Streams, Waterbodies	69 miles	1,044 stream miles
Nokomis fritillary butterfly	All Districts except Jicarilla	Riparian	Forest and Shrub Riparian, Wetland Riparian	Unknown based on the availability of violets	6,725 acres
Sangre de Cristo pea clam	Questa	Aquatic	Middle Fork Lake	8 acres	8 acres
American marten	Camino Real, Tres Piedras, Questa	High Elevation Forest	Spruce-Fir Forest	Unknown	276,196 acres
American pika	Camino Real, Tres Piedras, Questa	Non-forested, Rocky Features	Alpine and Tundra, Cliffs and Rocky Features	Unknown	9,996 acres
Gunnison's prairie dog	All	Non-forested	Montane Subalpine Grassland, Sagebrush	Unknown, Unknown number of colonies	184,495 acres,
Masked shrew	All Districts except Jicarilla	Non-forested, High Elevation Forest, Riparian	Montane Subalpine Grassland, Spruce-Fir Forest, Bristlecone Pine, Wetland Riparian, Forest and Shrub Riparian	Unknown	400,623 acres
Pale Townsend's big-eared bat	All	High Elevation Forest, Frequent Fire Forest, Cave-like/ Mine adit Structures	Spruce-Fir Forest, Mixed Conifer with Frequent Fire, Mixed Conifer with Aspen, Ponderosa Pine Forest, Caves and Abandoned Mines	Unknown	199,145 acres, 197 mine adits,
Spotted bat	All	Non-forested, Frequent Fire forest, Woodlands, Cliffs and Rocky Features	Montane Subalpine Grassland, Sagebrush, Mixed Conifer with Frequent Fire, Ponderosa Pine Forest, Piñon-Juniper Woodland, Piñon-Juniper Sagebrush, Cliffs and Rocky Features	Unknown	308,972 acres, Unknown amount of Rocky and Cliff Features
Water shrew	All Districts except Jicarilla	Riparian	Forest and Shrub Riparian	Unknown	15,043 acres

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Species	District	Vegetation Systems	Vegetation Community or Habitat Feature	Acres or Amount of Occupied Habitat	Potentially Suitable Habitat in each Vegetation Community or Number of Features Forestwide
Alpine larkspur	Questa, Camino Real	Non-forested, Rocky features	Alpine and Tundra, Cliffs and Rocky Features	4 occurrences Unknown acres	9,996 acres
Arizona willow	Camino Real, Tres Piedras, Questa	Riparian	Forest and Shrub Riparian	13 occurrences, 50 acres	4,671 acres
Chama blazing star	Canjilon, El Rito	Woodlands, Rocky Features	Piñon-Juniper Woodland, Piñon-Juniper Sagebrush, Cliffs and Rocky Features	10 occurrences, Unknown acres	32,350 acres
Pagosa milkvetch	Jicarilla	Frequent Fire Forest, Rocky Features	Ponderosa Pine Forest, Cliffs and Rocky Features	1 occurrence, Unknown acres	1,569 acres
Pecos fleabane	Camino Real, Questa	Non-forested, High elevation Forest, Rocky Features	Alpine and Tundra, Montane Subalpine Grassland, Spruce-Fir Forest, Mixed Conifer with Aspen, Cliffs and Rocky Features	1 occurrence, Unknown acres	16,605 acres
Ripley's milkvetch	Camino Real, Tres Piedras, Questa	Non-forested, Frequent Fire Forest, Woodlands	Sagebrush, Ponderosa Pine Forest, Piñon-Juniper Woodland Piñon-Juniper Sagebrush, PJS	31 occurrences, Unknown acres	56,707 acres
Robust larkspur	All Districts except Jicarilla	Non-forested, High Elevation Forest	Montane Subalpine Grassland, Spruce-Fir Forest	3 occurrences, Unknown acres	142,550 acres
Small-headed goldenweed	Tres Piedras	Frequent Fire Forest, Rocky Features	Ponderosa Pine Forest, Cliffs and Rocky Features	3 occurrences, Unknown acres	3 occurrences
Tufted sand verbena	Canjilon	Woodlands, Rocky Features	Piñon-Juniper Woodland, Piñon-Juniper Sagebrush, Cliffs and Rocky Features	2 occurrences, Unknown acres	2,437 acres
Yellow lady-slipper	Camino Real, Tres Piedras, Questa	High Elevation Forest	Spruce-Fir Forest	Unknown	179,755 acres

Jicarilla Natural Gas Management Area

All five alternatives include the Jicarilla Natural Gas Management Area. Under these alternatives, decisions regarding leasable mineral activities in the Jicarilla Natural Gas Management Area would align with law, regulation, and policy, and would be consistent with plan decisions for other resource areas to the extent possible.

Leasable mineral activities within the Jicarilla Natural Gas Management Area may have both short- and long-term adverse environmental consequences on sensitive species. Short-term effects could include increased human activity, such as motorized traffic, noise from drilling equipment, temporary roads, ground disturbance during drilling activities, and construction of authorized well pads, or pipelines. Long-term effects could include impacts operation and maintenance of the authorized facilities over the life of the facility. Operation and maintenance impacts may include increased human activity and noise, motorized vehicle traffic, or additional ground disturbance. The effects of these short- and long-term consequences could include wildlife displacement and habitat fragmentation.

Standards and guidelines requiring mitigation measures lessen these effects by protecting resources affected by mineral operations, including specific standards to ensure reclamation to stable, productive conditions consistent with forestwide desired conditions. Timing limitations on new drilling activity and completions limit disturbance and minimize risks to reproduction during critical breeding, fledging, and rearing periods. This ensures the health and persistence of these species on the landscape. Co-location of pipeline, road, and other infrastructure, road design limitations, and well siting measures that limit surface disturbance would decrease soil loss and compaction, vegetation removal, and habitat fragmentation. Avoidance of riparian areas would protect wildlife habitat and surface waters by reducing the probability for sedimentation along stream channels and spills near drainages.

Climate Change

Climate change has occurred to some degree and will continue in the future. Ramifications of a changing climate on wildlife are likely to include reduced snowfall or earlier snow melt in the spring, extended periods of drought or extended dry periods in the spring and summer, more frequent and larger wildfires, increased insect and disease-induced mortality, and changes in site characteristics that promote type conversion or vegetation community changes. This pattern is consistent with current trends in other parts of the west (Fettig et al. 2013).

These changes cause seasonal ranges and food sources for wildlife to shift and can affect the timing of reproduction. Reduced snowpack and changes in precipitation can affect amphibians by reducing water levels in lakes and ponds and can affect species that rely on deep or persistent snow. Forested tracts and remote habitats can also become isolated, reducing landscape connectivity and ecological condition for species with limited dispersal ability. The timing of spring green up can also affect food availability for migratory birds or forage conditions for big game. Those species with highly specialized ecological condition requirements, at the edge of their range, currently in decline, and/or having poor dispersal abilities may be particularly at risk (National Fish Wildlife and Plants Climate Adaptation Partnership 2012).

Climate change presents an aspect of uncertainty in future conditions, disturbance regimes, and vegetative and wildlife responses. Strategies that can be used to help reduce impacts from climate change include managing for diverse conditions, maintaining healthy and connected populations, reducing the risk of large uncharacteristic fire, preventing and controlling invasive species, and ensuring ecosystem processes and habitat connectivity (The Heinz Center 2008). While how well each of the alternatives addresses these strategies varies, it is assumed that to a certain extent, climate change and associated effects to wildlife would occur under all alternatives. The Climate Vulnerability Assessment for the Carson (USDA

FS 2014a) provides additional information on the vulnerability of the different vegetation communities and habitat types to climate change.

Summary

Under all alternatives, for all vegetation types except frequent fire forests, future management would be similar to current management, and consequently, environmental consequences are expected to be similar under all plan alternatives. All vegetation types are expected to remain either low- to moderately-departed (at risk) in the near and distant future ([Vegetation Communities and Fuels](#)). These same conditions and trends also apply to vegetation-related characteristics such as fire regime, patch size, species composition, ground cover, and soil condition, as these characteristics are intricately associated with, and are dependent on, vegetation structure.

The amount of high-elevation forest, non-forested, woodlands vegetation systems and abiotic features (including caves/mines, rocky outcrops, cliffs, canyon habitat, and soils) are not expected to change under any alternative. For the sensitive bat species, American peregrine falcon, burrowing owl, and Gunnison's prairie dog that depend on these vegetation and ecological condition, viability would be maintained through plan components that minimize risk for disturbance. Active management activities could affect individual animals but would not lead toward Federal listing or loss of viability.

For all alternatives, future management is concentrated in the Frequent Fire Forest, Riparian, and Aquatic systems which are the most highly departed from reference conditions. Management intensity in these systems varies by alternative but overall all alternatives move the Carson toward the desired state (table 5).

Environmental Consequences for Regional Forester's Sensitive Species – Alternative 1

The existing 1986 Forest Plan, as amended, was developed under the 1982 planning rule and would have impacts to sensitive species.

Key ecological conditions for sensitive species and key threats affecting those conditions are described below for all action alternatives which follows this section. Because the existing 1986 Forest Plan, as amended, was not explicitly developed using the coarse-filter, fine-filter approach (a key tenet of the species diversity requirements under the 2012 rule), alternative 1 would be largely limited to plan direction from the 1996 amendment, best management practices and site-specific mitigations done at the project level.

The 1986 Forest Plan, as amended, lacks a description of desired conditions for many of the key ecological characteristics for wildlife, making it harder to ensure projects are implemented in a consistent manner and that projects are moving toward a common set of desired conditions and long-term goals. The 1986 Forest Plan, as amended, does not define specific desired fire regimes, or contain objectives for frequency of fire to maintain or improve stand structure, maintain or decrease fuel loads, or to achieve other resource benefits. With the continued lack of fire disturbance, the risk of losing Frequent Fire Forest vegetation systems to stand-replacing wildfire and the resulting uncharacteristic open state increases over time. The potential loss of ecological condition components due to large, high-severity wildfires could have particularly negative effects on species like northern goshawk, pale Townsend's big-eared bat, spotted bat, Pagosa milkvetch, and robust larkspur. Frequent Fire forest, riparian, and aquatic systems are highly departed and trending away from reference conditions. Alternative 1 would continue to maintain current rates of planned and unplanned natural ignition and mechanical vegetation treatment which would move those vegetation states toward desired conditions at a slower rate than any of the action alternatives for frequent fire forest sensitive species. mixed conifer frequent fire would remain moderately departed under this alternative's desired condition after 15 years but would move closer to the desired state, changing from of departure of 64 percent to 54 percent. Ponderosa pine would remain highly departed

(82 percent), an improvement from current conditions (92 percent departure). This would be a slight overall improvement from current conditions.

Most of the standards and guidelines that have the potential to benefit wildlife in the current 1986 Forest Plan, as amended, are also found in the action alternatives in the form of desired conditions, guidelines, or management approaches. In many places, the current 1986 Forest Plan, as amended, reiterates existing law, regulation, or policy, but these are incorporated by reference in the action alternatives and are considered more specifically at the project level.

Prescriptive (restrictive) standards and guidelines in the 1986 Forest Plan, as amended, make it difficult to apply adaptive management as our understanding about management effects on ecosystems and wildlife changes. Adaptive management will be essential to effectively manage for climate change and invasive species in changing and uncertain conditions. Current direction for invasive species is primarily focused on noxious weeds. Climate change has the potential to affect all wildlife and plant species and influences the likelihood of large-scale disturbance (e.g., fire, bark beetle outbreaks) across the landscape. Alternative 1 does not recognize climate change and offers limited guidance associated with management activities (e.g., salvage logging, blow down) related to such disturbance events. Guidance for salvage operations is general in nature and focuses more on the enhancement of timber production rather than an integrated approach that balances management with other resource values such as wildlife habitat. The forest would continue to follow existing law, regulation, policy, and best management practices to address species viability concerns in areas affected by large-scale disturbance.

There is no recommended wilderness under alternative 1.

High-Elevation Forest (Bristlecone Pine, Spruce-Fir, and Mixed Conifer with Aspen communities) and Woodlands (Piñon-Juniper Woodland and Piñon-Juniper Sagebrush Woodland communities)

High-elevation sensitive species include American peregrine falcon, boreal owl, northern goshawk, American marten, masked shrew, pale Townsend's big-eared bat, Pecos fleabane, robust larkspur, and yellow lady slipper. Sensitive species that inhabit woodlands include American peregrine falcon, gray vireo, spotted bat, Chama blazing star, Ripley's milkvetch, and tufted sand verbena. Primary threats common to these species that use high-elevation forest and woodlands include the mature forest components, which include the loss of large trees and snags, down woody debris, and loss of interlocking canopy that provides nesting, roosting, and foraging habitat.

The current 1986 Forest Plan, as amended, lacks a description of desired conditions for many of the key ecological characteristics for wildlife within high-elevation forest and woodlands. However, the current 1986 Forest Plan, as amended, does provide guidance for individual sensitive species, or requires protection for sensitive species which are addressed outside the plan through site-specific best management practices. For peregrine falcon there is existing guidance to limit disturbance for essential nesting habitat and timing restrictions during the breeding season and there is also guidance for American marten to manage or enhance habitat in occupied marten habitat.

Boreal owl, American marten, gray vireo, spotted bat, and pale-Townsend's big-eared bat could be affected by fuelwood collection activities. Fuelwood collection would be managed through the permit system on the forest. Fuelwood permits would be maintained at the existing rate (approximately 15,500 cords annually) for a predicted 225,000 cords over the life of the plan. This is the same for all alternatives.

The quantity and quality of these vegetation communities is not expected to change under the current plan. high-elevation forest and woodland communities all have low to moderate departures from desired conditions, so there are no treatment objectives for these vegetation communities (see vegetation section).

It is expected that high-elevation forest would remain as low to moderate departed under this alternative after 15 years, and with given current rates of treatment, woodlands would improve to a low/moderate departure category (41 percent to 18 percent (PJO) and 64 percent to 36 percent (PJS).

Determination: Based on the analysis of plan components and the amount of habitat provided for each of the above species, viability would be maintained for each of the sensitive species dependent on high-elevation and woodland communities under the no-action alternative. While individual animals could be impacted by the actions under this alternative, the alternative would not lead toward Federal listing of the above sensitive species.

Frequent Fire Forest (Ponderosa Pine and Mixed Conifer Frequent Fire communities)

Frequent fire forest sensitive species include American peregrine falcon, bald eagle, northern goshawk, pale Townsend's big-eared bat, spotted bat, Pagosa milkvetch, Ripley's milkvetch, and small-headed goldenweed. Primary threats common to these species that use Frequent Fire Forest include the mature forest components which include the loss of, large trees and snags, down woody debris and loss of interlocking canopy which provide nesting, roosting and foraging habitat. Sensitive species that depend on fire adapted ecosystems would benefit from the 1996 plan amendment, which includes standards and guidelines supporting a variety of structural stages, canopy cover, and distribution of snags, large trees and coarse woody debris across the landscape. In addition, the current rate of treatment would continue to improve optimal habitat for these species. Based on vegetative dynamic digital tracking modeling (see appendix H for descriptions of vegetation states used) the following shows the change in frequent fire habitat conditions after 15 years:

- Goshawk habitat would increase from 19 percent to 45 percent (93,425 acres to 226,429 acres)
- American peregrine falcon, bald eagle, pale Townsend's big-eared bat, spotted bat, and Ripley's milkvetch habitat would increase from 14 percent to 20 percent (67,984 acres to 97,010 acres).⁷

Overall, habitat would increase for Frequent Fire Forest sensitive species under this alternative.

Determination: Based on the analysis of plan components and the amount of habitat provided for each of the above species, viability would be maintained for each of these species dependent on frequent fire forest communities under the no-action alternative. While individual animals could be impacted by the actions under this alternative, the alternative would not lead toward Federal listing of the above sensitive species. Beneficial impacts would include improvements in ecological conditions for foraging, breeding and dispersal.

Non-Forested Dependent Species (Alpine and Tundra, Montane and Subalpine Grassland, and Sagebrush)

Sensitive species that inhabit non-forested vegetation systems include northern leopard frog, American peregrine falcon, western burrowing owl, white-tailed ptarmigan, Gunnison's prairie dog, masked shrew, alpine larkspur, and Pecos fleabane.

The current plan has limited direction related to features needed by sensitive species that depend on alpine and tundra, grasslands, meadows, and sagebrush. These species and features are indirectly affected by standards and guidelines for recreational uses and sustainable rangelands and livestock grazing. Their main protection is the requirements to protect sensitive species which are addressed outside the plan and through site-specific best management practices. The quantity and quality of these ecosystems and associated habitat is not expected to change under the current 1986 Forest Plan, as amended. For peregrine falcon there is existing guidance to limit disturbance for essential nesting habitat and timing

⁷ Pagosa milkvetch and small-headed were not included as these species are more dependent on rock and soil features than vegetation.

restrictions during the breeding season. For prairie dogs, existing plan direction limits forage improvement activities and population control projects in areas where prairie dog towns exist to perpetuate the species, however, there is no mention of disease, which is the species' primary limiting factor. Burrowing owls are dependent on the presence of prairie dog colonies, which are largely impacted by disease. There is no mention of white-tailed ptarmigan and willow retention in the alpine and tundra for this species, other than general sensitive species statement. Masked shrew is largely dictated by the presence of leaf litter and moisture, which would be provided through understory components specified through the 1996 plan amendment. Sensitive plant species (alpine larkspur, and Pecos fleabane) found within non-forested vegetation which rely on soil moisture or rocky substrates would also be provided through understory components specified through the 1996 plan amendment.

Non-forested vegetation systems all have low to moderate departures from desired conditions, so there are no treatment objectives for these vegetation communities (see vegetation section). It is expected habitat condition would remain the same.

Determination: Based on the analysis of plan components and the amount of habitat provided for each of the above species, viability would be maintained for each of these species dependent on non-forested vegetation systems under alternative 1. While individual animals could be impacted by the actions under this alternative, the alternative would not lead toward Federal listing of the above sensitive species.

Riparian and Aquatic Associated Species

Sensitive species that depend on riparian or wetland habitat and either constructed or natural waters include northern leopard frog, western boreal toad, American peregrine falcon, bald eagle, Rio Grande cutthroat trout, Rio Grande chub, Rio Grande sucker, Nokomis fritillary butterfly, Sangre de Cristo pea clam, masked shrew, water shrew, and Arizona willow. Under the current 1986 Forest Plan, as amended, the objective of the sensitive species category is to keep these species off Federal lists through positive planning and management and ensure that sensitive species and their occupied habits will not be adversely impacted without a thorough analysis of significance of such impacts to prevent any trend toward Federal or state listing (USDA FS Carson NF 1986). The current plan does not have any specific direction for these species, does not recognize landscape pattern or connectivity for wildlife habitat selection, and limitedly recognizes of the role scale plays in wildlife habitat selection (Weins et al. 2012). Also, under the current 1986 Forest Plan, as amended, management standards or guidelines are not detailed enough on how to deal with invasive species and nonnative fish or amphibian species to improve this aquatic species habitat. Invasive species could limit the amount of habitat available to aquatic Sensitive species. However, there are several standards and guidelines in the current plan that protect wetland/aquatic habitat on the forest (Riparian-3 and Watershed-2) that include riparian habitat, road management, and grazing requirements. There is also the guideline to continue activities to improve Rio Grande cutthroat trout habitat with the objective of securing the species. These requirements would help maintain viability.

Another effect to riparian and aquatic dependent species is post-fire conditions. Post-fire conditions can affect downstream species populations. During storm events on recently burned areas, large quantities of sediment are frequently loaded into streams. Once in the watershed, the increased sediment load can cover substrate, decrease pool depth, diminish suitable spawning habitat, and reduce fitness by decreasing the nutritional value of the food base (Rees et al. 2005).

For these species, the amount of habitat is not likely to change from the current condition. There could be a slight increase in quality of habitat as projects come on line with current objectives to improve watershed health (300 acres per year) but would be achieved at a slower rate than the other alternatives. Alternative 1 would have the poorest outcome in terms of improving fire regime condition class and wetland integrity and the second poorest outcome in terms of improving stream health and riparian habitat ([Environmental Consequences for Watersheds and Water Resources](#)).

Determination: Based on the analysis of plan components and the amount of habitat provided for each of the above species, viability would be maintained for each of these species dependent on riparian/aquatic habitat under the no-action alternative. While individual animals could be impacted by the actions under this alternative, the alternative would not lead toward Federal listing of the above sensitive species. Beneficial impacts include slight improvements in riparian habitat and watershed condition class.

Special Habitat Features (Cave-like structures and Cliffs and Rocky features)

American peregrine falcon, American pika, pale Townsend's bat, spotted bat, alpine larkspur, Chama blazing star, Pagosa milkvetch, Pecos fleabane, Ripley's milkvetch, small-headed goldenweed, and tufted sand verbena are the sensitive species associated with cave-like structures, abandoned mines, rocky features, or cliffs. The current 1986 Forest Plan, as amended, has limited direction related to features needed by sensitive species that depend on caves, mines, rocky outcrops, or cliffs.

These species and features are indirectly affected by standards and guidelines for recreational uses, mineral development, and special use management. Their main protection is the requirements to protect sensitive species which are addressed outside the plan and through site-specific best management practices. The quantity and quality of these features is not expected to change under alternative 1. For peregrine falcon there is existing guidance to limit disturbance for essential nesting habitat and timing restrictions during the breeding season.

Determination: Based on the analysis of plan components and the amount of habitat provided for each of the above species, viability would be maintained for each of these species dependent on Special Habitat Features under the no-action alternative. While individual animals could be impacted by the actions under this alternative, the alternative would not lead toward Federal listing of the above sensitive species.

Summary

In summary, alternative 1 has general direction to protect the diversity of wildlife and plant communities and seral stages. However, plan direction is based on outputs, rather than outcomes, and fails to address current scientific thinking on the use of wildland fire and vegetation management as a way to promote ecological integrity, resilience, and wildlife diversity. Projects and activities would be guided by agency direction for managing federally listed species and direction to manage Regional Forester's sensitive species. Viability for sensitive species would be maintained or increased slightly under this alternative; however, this alternative would make the overall slowest progress for the most species in terms of wildlife ecological condition improvement compared to all of the alternatives.

Alternative 1 fails to address or poorly addresses the following over the life of the plan:

- Restoration would not happen at the pace and magnitude needed to have a marked effect on ecological resilience in a timely manner.
- Climate change, connectivity, and noxious invasive weeds are not explicitly recognized or incorporated.
- There is conflicting management direction for some species (e.g., northern goshawk).
- Monitoring plan lacks integration across resource areas, was not designed with the concept of adaptive management and does not consider key ecological conditions for species of conservation concern.
- There is no clear direction for watershed improvement or overall riparian health.
- There is no clear direction for specific plant species improvement or how to improve soil condition.
- Not based on current and emerging best available scientific information.

Environmental Consequences for Regional Forester's Sensitive Species Common to Alternatives 2, 3, 4, and 5

Action alternatives 2, 3, 4, and 5 are more strategic in nature and integrated than the current 1986 Forest Plan, as amended (alternative 1). All action alternatives include plan direction designed to maintain the diversity of plant and animal communities and support the persistence of native species within the plan area, subject to the extent of Forest Service authority and the inherent capability of the plan area.

Substantive differences among action alternatives include six place-based management areas, each having their own set of plan components. Other substantive differences between action alternatives that could impact wildlife include the amount of recommended wilderness being proposed, the role of mechanical treatments and wildland fire as restoration tools, the amount of riparian/aquatic systems restored, and the amount of roads maintained or decommissioned for ecosystem health. Current science recognizes both wildland fire and vegetation management as tools through which ecological integrity and resilience can be managed (C. Miller and Aplet 2016; Reynolds et al. 2013). The action alternatives more proactively incorporate this thinking. All action alternatives would provide for a substantial increase in both prescribed fire and unplanned natural ignitions that are managed for resource benefits. This would have positive effects for species that use Frequent Fire Forest as well as riparian and aquatic associated species by decreasing the chance for stand-replacing wildfires, and thereby decreasing sedimentation from fire flood events. The action alternatives also make better use of partnerships and collaboration to maintain ecosystem integrity and resilience. Current science suggests that conservation partnerships are becoming increasingly important to adaptively manage for climate change (Monahan and Theobald 2018).

As mentioned for alternative 1, adaptive management will be essential to effectively manage for climate change and associated impacts from disturbance events, livestock grazing, and invasive species in changing and uncertain conditions. As a result, the action alternatives include a monitoring plan designed to better inform the effects and effectiveness of management and progress toward desired conditions. Alternatives 2, 3, 4, and 5 better recognize and address the negative effects nonnative invasive species and disease can have on ecosystem integrity and biological diversity. Direction for invasive species was updated and expanded to recognize the threats to ecosystem resilience from all nonnative, invasive aquatic and terrestrial plants and animals likely to cause harm to ecosystems. Finally, climate change may push rare and endemic species to the limits of their range and evolutionary capacity. This is expected to be especially significant in the Southwest, an area already affected by long-term drought. The action alternatives recognize and include plan components to help address that threat and to reduce the risk of removing ecological condition for those types of species.

For some species, where disease is a primary risk factor, it will be hard for the forest to mitigate risk beyond the forest boundaries. This includes the following sensitive species: pale Townsends big eared bat, spotted bat, Western boreal toad, Northern leopard frog, burrowing owl, and Gunnison's prairie dog. For these species it will be difficult to prevent intermingling with diseased animals that may come and go from the forest. Effects of all action alternatives for these species would be similar as they relate to managing for the outbreak or continuation of disease contact or spread for sensitive species.

Recommended wilderness is proposed under alternatives 2, 4, and 5 (table 36). Recommended wilderness beneficially affects sensitive species through its primitive management, which minimizes disturbance to sensitive species and provides habitat connectivity. However, the Carson would also be more limited in its ability to treat these areas and would rely on wildland fire as its main restoration tool. Limiting the ability to treat these areas may leave these areas vulnerable to large, stand-replacing wildfire and cause these areas to become more departed in the future. More departed ecological conditions in the future may negatively affect sensitive species dependent on this habitat. Alternative 2 identifies 9,189 acres for recommended wilderness, while alternative 5 would include the most recommended wilderness (67,996 acres).

Explicit forestwide plan direction that includes beneficial language to mitigate negative impacts on sensitive species and wildlife, in general, for climate change, nonnative invasive species, disease, and connectivity which are missing from alternative 1 include, but are not limited to, plan components found in table 37 to table 39 of the Federally Listed Species section.

These plan components would be beneficial for all wildlife, plant, and aquatic species, but especially those species that depend on riparian systems, frequent-fire adapted ecosystems, aquatic systems, endemic species/species with restricted distributions, and species that move across large landscapes and use habitat at multiple spatial scales. These plan components would benefit wildlife species by supporting resilient and resistant ecosystems and watersheds, which would protect species from the negative effects of climate change and would give wildlife species the best opportunity to adapt to changing conditions. This type of plan language, which can be found in the action alternatives, is not explicitly called out under alternative 1 and should have a more positive effect on all sensitive species under all action alternatives.

Sensitive species, habitat capability, and threats are broadly defined below for all action alternatives. Species have been grouped according to the primary ecological needs and threats, to help eliminate redundancy in the analysis. Refer to the affected environment ([Ecological Conditions](#)) for the vegetation community and current departure and trend for each vegetation community associated with sensitive species.

High-Elevation Forest and Woodlands

Primary threats common to sensitive species that use high-elevation forest and woodlands include the mature forest components, which include the loss of large trees and snags, down woody debris, and loss of interlocking canopy that provide nesting, roosting and foraging habitat from management actions such as fire, fuelwood collection, and restoration. These species would benefit from desired conditions, standards, and guidelines that promote the retention of these features at different spatial scales across the landscape. Plan components for high-elevation forest and woodlands would mitigate those risks.

In addition, forestwide plan components under Wildlife, Fish, and Plants, Wildland Fire Management, Sustainable Rangelands and Livestock Grazing, and Sustainable Forestry and Forest Products would help to ensure that species-specific needs would be met during site-specific projects. These components would help to mitigate the effects from ground-disturbing projects and provide protection from management activities. Some species may experience short-term, adverse effects from implementing these actions, but the long-term net gain would be positive by striving to create ecological balance and restoring the natural role of fire in the system.

The quantity and quality of these communities is not expected to change under any action alternative. high-elevation forest and woodland communities all have low to moderate departures from desired conditions, so there are no treatment objectives for these Vegetation communities ([Vegetation Communities and Fuels](#)). It is expected that high-elevation forest and woodlands would remain at low to moderate departed under these alternatives after 15 years.

Determination: Based on the analysis of plan components and the amount of habitat provided for each of the above species, viability would be maintained for each of these species dependent on high-elevation and woodland communities under all action alternatives. While individual animals could be impacted by the actions under any action alternative, none of the action alternatives would lead toward Federal listing of the above sensitive species.

Frequent Fire Forest

Primary threats common to the sensitive species that use frequent fire forest include the mature forest components, which include the loss of large trees and snags, down woody debris, and loss of interlocking canopy that provide nesting, roosting and foraging habitat from management actions such as fire,

fuelwood collection, and restoration. These species would benefit from desired conditions, standards, and guidelines that promote the retention of these features at different spatial scales across the landscape. Plan components for Frequent Fire Forest would mitigate those risks.

In addition, forest wide plan components under Wildlife, Fish, and Plants, Wildland Fire Management, and Sustainable Forestry and Forest Products would help to ensure that species specific needs would be met during site-specific projects. These components would help to mitigate the effects from ground-disturbing projects and provide protection from management activities. Some species may experience short-term, adverse effects from implementing these actions, but the long-term net gain would be positive by striving to create ecological balance and restoring the natural role of fire in the system. Objectives and effects differ across the action alternatives for Frequent Fire Forest and the total amount of habitat moved toward desired conditions after 15-year life of the plan varies for each habitat type across alternatives. The differing amounts of habitat improved are highlighted in the individual sections for each alternative in their respective sections.

Non-Forested Dependent Species

Viability for species that utilize non-forested vegetation systems is largely realized through desired conditions, standards, and guidelines for alpine and tundra, montane and subalpine grassland, and sagebrush vegetation communities and through the Wildlife, Fish, and Plants, Nonnative Invasive Species, Sustainable Rangelands and Livestock Grazing, and Sustainable Forestry and Forest Products program areas. The quantity and quality of these communities is not expected to change under any action alternative. Non-forested vegetation systems all have low to moderate departures from desired conditions, so there are no treatment objectives for these vegetation communities (see [vegetation section](#)). However, effects differ across the action alternatives and the total amount of habitat moved toward desired conditions over the 15-year life of the plan varies for each habitat type across alternatives. The differing amounts of habitat improved are highlighted in the individual sections for each alternative in their respective sections.

Livestock grazing would continue to be managed under all alternatives, and can trample, alter plant community structure, species composition, relative abundance of species, and vegetative density for these non-forested dependent species. Plan components for the sustainable rangelands and livestock grazing program areas (FW-GRZ-DC-4-6; FW-GRZ-S-1; FW-GRZ-G-2-3) emphasize that livestock grazing within non-forest vegetation types must be compatible with ecological function and the needs of wildlife species. These plan components would be beneficial by balancing multiple use with healthy non-forested vegetation types and moving these vegetation types toward desired conditions over the 15-year life of the plan under all alternatives. Over the last decade, the Carson range staff has worked with partners and permit holders to manage grazing pressure on sensitive areas (such as critical areas and riparian areas).

Riparian and Aquatic Associated Species

Riparian habitat includes wetlands and forested riparian (i.e., willow, cottonwood, and alder) areas surrounding Aquatic ecosystems (seeps/springs, perennial streams, lakes, and other water features). Riparian and Aquatic ecosystems occupy a very small portion of the forest and are highly departed. Species associated with this type of ecosystems would benefit from plan objectives that move aquatic/riparian habitats toward the desired state. The objectives and effects differ across action alternatives and the total amount of habitat moved toward desired conditions over the 15-year life of the plan varies for each habitat type across alternatives. The differing amounts of habitat improved are highlighted in the individual sections for each alternative in their respective sections.

Livestock grazing would continue to be managed under all alternatives, and can trample, alter plant community structure, species composition, relative abundance of species, vegetative density, and alter stream channel morphology for these riparian species. Plan components for the sustainable rangelands

and livestock grazing program areas (FW-GRZ-DC-4-6; FW-GRZ-S-1; FW-GRZ-G-2-3) emphasize that livestock grazing within riparian management zones must be compatible with ecological function and the needs of at-risk species, and that desired conditions for riparian vegetation and proper stream channel morphology and floodplain function are sustained. These plan components would be beneficial by balancing multiple use with healthy riparian systems and moving these riparian systems toward desired conditions over the 15-year life of the plan under all alternatives. Over the last decade, the Carson range staff has worked with partners and permit holders to manage grazing pressure on sensitive areas (such as critical areas and riparian areas).

Plan components under the Wildlife, Fish, and Plants, Nonnative Invasive Species, All Vegetation, Wildland Fire Management, and All Watershed Resources sections would benefit the majority of Riparian and Aquatic associated sensitive species and are within all action alternatives. Additional plan components which balance multiple use with wildlife needs can be found under the Sustainable Rangelands and Livestock Grazing Management, Transportation and Forest Access, Recreation, and Special Uses sections.

Special Habitat Features

Viability for species that utilize caves, mines, rocky features, and cliff habitat would be maintained through the Caves and Abandoned Mines, Cliffs and Rocky Features, Recreation, Special Uses, and Minerals and Mining section. The quantity and quality of these communities is not expected to change under any action alternative.

Determination: Based on the analysis of plan components and the amount of habitat provided for each of the above species, viability would be maintained for each of these species dependent on Special Habitat Features under any action alternative. While individual animals could be impacted by the actions under any action alternative, none of the action alternatives would lead toward Federal listing of the above sensitive species.

Environmental Consequences for Regional Forester's Sensitive Species – Alternatives 2 and 5

Alternatives 2 and 5 retain relevant plan direction from alternative 1 but are more responsive to current science and thinking while addressing the core themes and significant issues explored during the plan revision process. The only difference between alternatives 2 and 5 is the amount of recommended wilderness, which was discussed in the effects common to all action alternatives. The primary difference between alternatives 2 and 5 and the other alternatives is the addition of three, place-based management areas with their own plan components, variation among management objectives and restoration, and objectives for road management. All other plan components would remain the same as those listed under All Action Alternatives. In addition to the environmental consequences for all alternatives above, alternatives 2 and 5 would primarily differ from alternative 1 in the rate and magnitude of ecological condition restored for riparian dependent species and species affected by frequent-fire adapted ecosystem treatment.

Frequent Fire Forest

Frequent Fire Forest sensitive species include American peregrine falcon, bald eagle, northern goshawk, pale Townsend's big-eared bat, spotted bat, Pagosa milkvetch, Ripley's milkvetch, and small-headed goldenweed. Sensitive species that depend on Frequent Fire Forest would benefit from plan components described under All Action Alternatives, however, optimal habitat for each species varies. Frequent Fire Forest vegetation community is moderately to highly departed and trending away from reference conditions (see affected environment above and vegetation section of this document). Alternatives 2 and 5 would increase the current rate of mechanical treatment (27,500 to 60,000 acres during each 10-year period) and the current rate of wildland fire (100,000 to 165,000 acres during each 10-year period).

After 15 years desired conditions for mixed conifer would remain moderately departed but would move closer to the desired state, changing from departure of 64 percent to 43 percent. Ponderosa Pine would remain highly departed, but would move closer to the desired state, changing from 92 percent to 59 percent. This would be an improvement over alternative 1 for species that depend on frequent fire adapted ecosystems.

Based on vegetative dynamic digital tracking modeling, the following shows the change in frequent fire habitat conditions in 15 years for Frequent Fire Forest:

- Goshawk habitat would increase from 19 percent to 54 percent (93,425 acres to 269,396 acres)
- American peregrine falcon, bald eagle, pale Townsend's big-eared bat, spotted bat, and Ripley's milkvetch habitat would increase from 14 percent to 42 percent (67,984 acres to 208,472 acres).

Optimal habitat for the frequent fire forest associated sensitive species would be more than alternative 4 but less than alternative 3.

Under alternatives 2 and 5, increased levels of mechanical and restoration treatments from objectives would cause increased temporary ground disturbance to Frequent Fire Forest sensitive species. However, within these alternatives plan components specifically addressing soil and ground disturbance are found throughout all sections of the plan (FW-VEG-G 2, FW-SOIL-G-1 and 2, FW-WSW-DC 2, FW-GRZ-G 4-5, FW-TFA-G 1-2, FW-TFA-G 9, FW-REC-G 1, FW-FFP-S 2, FW-FFP-G-3, and FW-SU-G-1-3). There are also plan components and objectives (FW-TFA-O 1, FW-TFA-G 3 and 4, and FW-REC-O 6) within this alternative that seek to rehabilitate areas that are disturbed.

Determination: Based on the analysis of plan components and the amount of habitat provided for each of the above species, viability would be maintained for each of these species dependent on Frequent Fire Forest habitat under alternatives 2 and 5. While individual animals could be impacted by the actions under these alternatives, the alternatives would not lead toward Federal listing of the above sensitive species. Beneficial effects include improvements in nesting, roosting, and foraging habitat.

Non-Forested Dependent Species

Sensitive species that inhabit non-forested vegetation systems include: Northern leopard frog, American peregrine falcon, Western burrowing owl, white-tailed ptarmigan, Gunnison's prairie dog, masked shrew, alpine larkspur, and Pecos fleabane.

Alternatives 2 and 5 include plan components for Grassland Maintenance Management Area, which is within portions of all ranger districts. Grassland Maintenance Management Area desired condition MA-GMMA-DC 1 preserves woodlands and Ponderosa Pine Forest in a treeless state to promote forage production. Areas within this management area have been preserved in a treeless state for over 50 years. This management area would increase the amount of grassland habitat and the quality of grassland (MA-GMMA-DC 2-3) for sensitive species such as burrowing owl, American peregrine falcon, and Gunnison prairie dog.

Determination: Based on the analysis of plan components and the amount of habitat provided for each of the above species, viability would be maintained for each of these species dependent on Non-forested Habitat under alternatives 2 and 5. While individual animals could be impacted by the actions under these alternatives, these alternatives would not lead toward Federal listing of the above sensitive species.

Riparian and Aquatic Associated Species

Sensitive species that depend on riparian or wetland habitat and either constructed or natural waters include northern leopard frog, western boreal toad, American peregrine falcon, bald eagle, Rio Grande cutthroat trout, Rio Grande chub, Rio Grande sucker, Nokomis fritillary butterfly, Sangre de Cristo pea

clam, masked shrew, water shrew, and Arizona willow. Watershed resources, Riparian, and Aquatic Habitats are highly departed and are trending away from reference conditions. Alternatives 2 and 5 set objectives to restore structure and function of at least 200 to 300 acres of riparian areas annually, and objectives to restore, enhance, or maintain 100 to 150 stream miles, and 10 to 20 springs during each 10-year period. This also includes objectives (FW-TFA-O 1-3) and guidelines (FW-TFA-G 2 and 7) to maintain or decommission roads to improve watershed health. Alternatives 2 and 5 also set objectives and include plan components (FW-WSW-DC 4-5; FW-WSW-RMZ-DC 2; FW-WSW-RMZ-STM-DC 2-3, 9; FW-WFP-DC 1-4; FW-WFP-O 3-5) to maintain or restore the distribution of native aquatic species of conservation concern, especially Rio Grande chub, Rio Grande cutthroat trout, and Rio Grande sucker. Treatments may occur anywhere on the Carson, where they are determined to be appropriate. These plan components would move riparian and aquatic ecological condition across the forest closer to a desired state and would increase native aquatic species distribution. Moving toward desired conditions would improve ecological conditions necessary for riparian and aquatic sensitive species by decreasing sedimentation and improving seral state distribution, surface flow timing and duration, and repairing disconnected floodplains. Improving native aquatic species distribution by improving ecological condition, improving habitat connectivity, and removing nonnative species competition, in coordination with New Mexico Department of Game and Fish, would increase viability of aquatic sensitive species across the forest.

Under alternatives 2 and 5, increased levels of restoration treatments from objectives would cause increased temporary ground disturbance to riparian and aquatic dependent sensitive species. However, within these alternatives, plan components specifically addressing soil and ground disturbance are found throughout all sections of the plan (FW-VEG-G 2, FW-SOIL-G-1 and 2, FW-WSW-DC 2, FW-GRZ-G 4-5, FW-TFA-G 1-2, FW-TFA-G 9-10, FW-REC-G 1, FW-FFP-S 2, FW-FFP-G-3, and FW-SU-G-1-3). There are also plan components and objectives (FW-TFA-O 1, FW-TFA-G 3 and 4, and FW-REC-O 6) within this alternative that seek to rehabilitate areas that are disturbed.

For these Riparian and Aquatic associated sensitive species, the amount of habitat and the quality of habitat would increase from the current condition. Desired conditions would be achieved at a faster rate than alternative 1, and at the same rate as the other action alternatives ([Environmental Consequences for Watersheds and Water Resources](#)).

Determination: Based on the analysis of plan components and the amount of habitat provided for each of the above species, viability would be maintained for each of these species dependent on Riparian/Aquatic Habitat under alternatives 2 and 5. While individual animals could be impacted by the actions under these alternatives, these alternatives would not lead toward Federal listing of the above sensitive species.

All Sensitive Species

Alternatives 2 and 5 include plan components for two other management areas as well that could impact all sensitive species and that differ from alternatives 3 and 4. These include the Valle Vidal Management Area (Questa Ranger District) and the San Antonio Management Area (Tres Piedras Ranger District). Valle Vidal Management Area (MA-VVMA-DC 1, 2, 4, and 5) and San Antonio Management Area (MA-SAMA-DC 1, 3-4) are managed for multiple uses, focusing on the restoration and protection of diverse, resilient, biological communities for future generations, while providing a quality backcountry outdoor recreation experience. Valle Vidal and San Antonio Management Areas limit development and road construction. Existing closed and non-system roads would continue to naturalize and would diminish watershed and ecological condition impacts from sedimentation and habitat segmentation. Limiting development and road construction within these management areas would increase ecological conditions, but not necessarily increase the amount of habitat for all sensitive species found within these management areas.

Environmental Consequences for Regional Forester's Sensitive Species – Alternative 3

The primary difference between alternative 3 and the other alternatives is the addition of two place-based management areas (Grassland Maintenance Management Area and Off-Highway Vehicle Management Area) with their own unique plan components, and the expansion of the developed winter and summer resort management area boundary. The San Antonio and Valle Vidal Management Areas found in alternatives 2, 4, and 5 are not included in this alternative. Alternative 3 uses mechanical treatment, wildfire, and fuelwood collection to decrease risk from stand-replacing wildfire and to improve ecosystem function. All other plan components would remain the same as those listed under all action alternatives.

Alternative 3 has higher restoration objective acres than any other alternative for fire-adapted ecosystems, and sustainability of springs, wetlands, and riparian areas (improved watershed health). An increased emphasis on restoration intensity emphasizes partnerships to get more work done on the ground to achieve desired conditions at a greater rate than the other alternatives. This should benefit most species that depend on fire-adapted and riparian ecosystems by improving ecological condition at a faster rate and higher intensity in areas that need it most.

This alternative places more emphasis on human uses, therefore, road maintenance is emphasized, with the potential to increase road use. Temporary roads would be considered for inclusion into the system to support multiple use activities and access to the forest as an alternative to decommissioning. In addition, this alternative proposes off-highway vehicle management area in the Camino Real Ranger District. The off-highway vehicle management area would allow cross-country travel opportunities within the management area to provide challenging terrain for trials motorcycles and off-highway vehicle rock crawling. The added footprints of increased road activity and the proposed off-highway vehicle management area would increase ground and soil disturbance and would increase intrusive human activities (vehicle noise) that would negatively impact all sensitive species.

Frequent Fire Forest

Frequent fire forest sensitive species include American peregrine falcon, bald eagle, northern goshawk, pale Townsend's big-eared bat, spotted bat, Pagosa milkvetch, Ripley's milkvetch, and small-headed goldenweed. Using mechanical treatments within frequent fire forest under alternative 3, there would be an increase to 65,000 to 130,000 acres treated during each 10-year period. Acres treated using prescribed fire would remaining the same as alternatives 2 and 5 (100,000 to 165,000 acres during each 10-year period). Under alternative 3, in 15 years desired conditions for mixed conifer would remain moderately departed but would move closer to the desired state, changing from departure of 64 percent to 33 percent. Ponderosa pine would become moderately departed (41 percent); an improvement from current conditions (92 percent departure). For species that depend on fire adapted ecosystems, this alternative would realize the greatest overall improvement in ecological condition out of all alternatives, and would benefit such species as northern goshawk, American peregrine falcon, bald eagle, pale Townsend's big-eared bat, spotted bat, and Ripley's milkvetch. However, widespread mechanical treatment under alternative 3 would result in the most ground disturbance and associated effects to understory vegetation than other alternatives. Localized, short-term impacts to soil stability and erodibility, with subsequent watershed impacts such as increased sedimentation would be more likely. There may be a higher probability of localized invasive species distribution and establishment in disturbed areas. Increased sedimentation, increased ground disturbance, and increases in invasive species distribution would negatively impact sensitive species.

Based on vegetative dynamic digital tracking modeling, the following shows the change in frequent fire habitat conditions in 15 years for frequent fire forest:

- Goshawk habitat would increase from 19 percent to 63 percent (93,425 acres to 315,314 acres)

- American peregrine falcon, bald eagle, pale Townsend's big-eared bat, spotted bat, and Ripley's milkvetch habitat would increase from 14 percent to 57 percent (67,984 acres to 283,079 acres).

The Developed Winter and Summer Resort Management Area comprises the permitted ski areas on the Carson. This management area is currently managed in an altered vegetative state from reference condition and would continue to be managed as such under alternative 3. However, under this alternative the Developed Winter and Summer Resort Management Area would be expanded by 921 acres around the Sipapu Ski and Summer Resort. The current Sipapu permitted boundary is 215 acres and would not change under any alternatives except alternative 3 where it would likely be expanded through a separate analysis. Expansion of this boundary would alter current vegetation from a forested to a grassland state, thereby possibly decreasing Frequent Fire Forest ecological conditions, decreasing habitat connectivity, and would possibly increase ground disturbance and human intrusive disturbance from ski area development within the expanded part of this management area for frequent fire forest sensitive species. Effects from the current permitted boundary for this management area are analyzed under Environmental Consequences Common to All Alternatives

Determination: Based on the analysis of plan components and the amount of habitat provided for each of the above species, viability would be maintained for each of these species dependent on frequent fire forest habitat under alternative 3. While individual animals could be impacted by the actions under this alternative, the alternative would not lead toward Federal listing of the above sensitive species.

Non-Forested Dependent Species

Sensitive species that inhabit non-forested vegetation systems include northern leopard frog, American peregrine falcon, western burrowing owl, white-tailed ptarmigan, Gunnison's prairie dog, masked shrew, alpine larkspur, and Pecos fleabane. Grassland Maintenance Management Area (forestwide) is also proposed under this alternative, and effects from plan components for Grassland Maintenance Management Area would be the same as described for alternatives 2 and 5.

Determination: Based on the analysis of plan components and the amount of habitat provided for each of the above species, viability would be maintained for each of these species dependent on non-forested Habitat under alternative 3. While individual animals could be impacted by the actions under this alternative, this alternative would not lead toward Federal listing of the above sensitive species.

Riparian and Aquatic Associated Species

Sensitive species that depend on riparian or wetland habitat and either constructed or natural waters include northern leopard frog, western boreal toad, American peregrine falcon, bald eagle, Rio Grande cutthroat trout, Rio Grande chub, Rio Grande sucker, Nokomis fritillary butterfly, Sangre de Cristo pea clam, masked shrew, water shrew, and Arizona willow. Sensitive species that depend on riparian or wetland habitat and either constructed or natural waters would realize a modest improvement in habitat. Alternative 3 set the same objectives as alternatives 2 and 5 to restore structure and function of at least 200 to 300 acres of riparian areas annually, and objectives to restore, enhance, or maintain 100 to 150 stream miles, and 10 to 20 springs during each 10-year period. This alternative also set objectives and includes plan components (FW-WSW-DC 4-5; FW-WSW-RMZ-DC 2; FW-WSW-RMZ-STM-DC 2-3, 9; FW-WFP-DC 1-4; FW-WFP-O 3-5) to maintain or restore the distribution of native aquatic Sensitive species, especially Rio Grande chub, Rio Grande cutthroat trout, and Rio Grande sucker. Treatments may occur anywhere on the Carson, where they are determined to be appropriate. These plan components would move riparian and aquatic ecological condition across the forest closer to a desired state and would increase native aquatic species distribution. Moving toward desired conditions would improve ecological conditions necessary for riparian and aquatic sensitive species by decreasing sedimentation and improving seral state distribution, surface flow timing and duration, and repairing disconnected floodplains. Improving native aquatic species distribution by improving ecological condition, improving habitat

connectivity, and removing nonnative species competition, in coordination with New Mexico Department of Game and Fish, would increase viability of aquatic sensitive species across the forest.

However, this alternative places more emphasis on human uses, therefore, road maintenance is emphasized with the potential to increase road use. Temporary roads would be considered for inclusion into the system to support multiple-use activities and access to the forest as an alternative for decommissioning. In addition, this alternative proposes off-highway vehicle management area in the Camino Real Ranger District. The off-highway vehicle management area would allow cross-country travel opportunities within the management area to provide challenging terrain for trials motorcycles and off-highway vehicle rock crawling. The added footprints of increased road activity and the proposed off-highway vehicle management area would increase ground and soil disturbance and would increase intrusive human activities (vehicle noise) that would negatively impact all sensitive species, especially riparian and aquatic sensitive species.

This alternative with the increased mechanical treatment would move departed ecological condition of Frequent Fire Forest toward desired condition the fastest. However, the increased mechanical treatment, potential to increase road use, and the inclusion of off-highway vehicle management area would have the greatest increase in ground disturbance. Watershed conditions would be worse compared to alternative 2, with cascading impacts on riparian function, thereby, negatively impacting riparian and aquatic sensitive species.

Determination: Based on the analysis of plan components and the amount of habitat provided for each of the above species, viability would be maintained for each of these species dependent on aquatic and riparian habitat under alternative 3. While individual animals could be impacted by the actions under this alternative, the alternative would not lead toward Federal listing of the above sensitive species. Beneficial impacts include a slight improvement in potentially suitable habitat in riparian and spring areas resulting from improved water features, and hydrology as a result of increased treatment rates in the Mixed Conifer and Ponderosa Pine vegetation types. The lower risk from large stand-replacing wildfire would also decrease negative effects from associated sedimentation and discharge which can occur as a result of this events. However, there would also be negative impacts such as increased sedimentation and increase intrusive human activities from the increase road use.

Environmental Consequences for Regional Forester's Sensitive Species – Alternative 4

The primary difference between alternative 4 and the other alternatives is the greater use of naturally ignited wildfires and prescribed fires to achieve restoration objectives (125,000 to 225,000 acres during each 10-year period). Mechanical treatment would focus on treating fuels to protect communities instead of forestwide restoration. Alternative 4 also includes four placed-based management areas that would have their own plan components. Otherwise, forestwide plan components would be the same as described above under Environmental Consequences for All Action Alternatives. Under this alternative, unplanned ignitions would be encouraged to play their natural role in ecosystems at the landscape level more than other alternatives. Current thinking on fire and its use has evolved over the last 50 years and the scientific community now recognizes the beneficial effects lower intensity wildfire may have on forest structure and wildlife ecological condition (Millar and Stephenson 2015; C. Miller and Aplet 2016). A caveat to this would be high-intensity landscape-scale fires that would be detrimental to wildlife species that use frequent fire-adapted systems.

Proposed management areas under alternative 4 include: Wetland Jewels Management Area (forestwide), Valle Vidal Management Area (Questa Ranger District), San Antonio Management Area (Tres Piedras Ranger District), and Rio Grande Cutthroat Trout Management Area (forestwide). Grassland Maintenance Management Area is not proposed under this alternative; therefore, these areas would revert to woodlands or ponderosa pine forest under this alternative. Woodland and ponderosa pine-dependent sensitive species

would have more acres available under this alternative, but grassland ecological conditions would decrease for grassland-dependent sensitive species.

Alternative 4 would also limit motorized access through several means including stricter guidance regarding the creation of new permanent or temporary roads (FW-TFA-S 3-4), obliterating or naturalizing double the number of miles of non-system roads (FW-TFA-O 1), expanding the San Antonio Management Area and requiring seasonal closures (MA-SAMA-S 8-9), prohibiting new motorized trails within Valle Vidal and San Antonio Management Areas (MA-VVMA-S- 24, MA-SAMA-S-12), and prohibiting new permanent roads or motorized trails in the Wetland Jewels Management Area (MA-WJMA-S-1). Riparian impacts such as sedimentation and vegetation removal would be slightly reduced overall. Invasive species spread would be slowed somewhat due to reduced access by motorized vectors, but treatment to restore riparian function may also be made more difficult in some locations. Decreases in ground disturbance, intrusive human activity, sedimentation, and distribution of invasive species would beneficially impact sensitive species.

Valle Vidal and San Antonio Management Areas would have similar effects as discussed for alternatives 2 and 5, with the exception of the above discussion on limiting motorized access.

Frequent Fire Forest

Frequent fire forest sensitive species include American peregrine falcon, bald eagle, northern goshawk, pale Townsend's big-eared bat, spotted bat, Pagosa milkvetch, Ripley's milkvetch, and small-headed goldenweed. After 15 years under alternative 4, desired conditions for mixed conifer with frequent fire would remain moderately departed but would move closer to the desired state, changing from departure of 64 percent to 44 percent. Ponderosa pine forest would remain highly departed (71 percent) a moderate improvement from current conditions (92 percent departure). For sensitive species that depend on frequent fire adapted ecosystems, this alternative would be similar to alternative 2 in terms of overall ecological condition improved for these two vegetation types. However, the decrease of mechanical treatment could also put these species at greater risk for reductions of foraging, nesting, and roosting habitat resulting from uncharacteristic stand-replacing wildfire.

Based on vegetative dynamic digital tracking modeling, the following shows the change in frequent fire habitat conditions in 15 years:

- Goshawk habitat would increase from 19 percent to 46 percent (93,400 acres to 231,848 acres)
- American peregrine falcon, bald eagle, pale Townsend's big-eared bat, spotted bat, and Ripley's milkvetch habitat would increase from 14 percent to 27 percent (68,670 acres to 131,418 acres).

This alternative would increase the amount of optimal habitat improved for these species more than alternative 1, but less than the other action alternatives.

Determination: Based on the analysis of plan components and the amount of habitat provided for each of the above species, viability would be maintained for each of these species dependent on conifer habitat under alternative 4. While individual animals could be impacted by the actions under this alternative, the alternative would not lead toward Federal listing of the above sensitive species.

Riparian and Aquatic Associated Species

Sensitive species that depend on riparian or wetland habitat and either constructed or natural waters include northern leopard frog, western boreal toad, American peregrine falcon, bald eagle, Rio Grande cutthroat trout, Rio Grande chub, Rio Grande sucker, Nokomis fritillary butterfly, Sangre de Cristo pea clam, masked shrew, water shrew, and Arizona willow. Alternative 4 has the same Watershed, Riparian, and Aquatic objectives as alternative 2, however, these objectives are focused in Wetland Jewels Management Area and Rio Grande Cutthroat Trout Management Area.

Wetland Jewels Management Area would focus road obliteration and riparian restoration work in these areas rather than in priority watersheds, which is where riparian restoration activities are focused in all other action alternatives. The efficacy or feasibility of treating these areas is not clearly greater than they are for treating other locations on the forest. In fact, treatment return on investment is likely to be low since 49 percent of the Wetland Jewels Management Area is in either designated wilderness, recommended wilderness, or inventoried roadless areas, each of which restricts management options compared to other forest areas. For example, earth work or moving boulders by hand is costlier, time consuming, and labor intensive than doing the same work with machinery (refer to [riparian vegetation section](#)). Wetland Jewels Management Area should benefit aquatic and riparian sensitive species within the management area, but emphasis on aquatic and riparian restoration within this management area would improve forestwide ecological conditions for riparian and aquatic vegetation communities at a slower rate than other action alternatives.

The Rio Grande Cutthroat Trout Management Area would focus native aquatic species restoration work in these areas, rather than forestwide or at the discretion of the New Mexico Department of Game and Fish. Treatments (MA-RGCTMA-O-1) to remove nonnative species and desired condition (MA-RGCTMA-DC 1) that improves connectivity and ecological condition within the Rio Grande Cutthroat Trout Management Area would increase native aquatic species distribution, within this management area.

Determination: Based on the analysis of plan components and the amount of habitat provided for each of the above species, viability would be maintained for each of these species dependent on aquatic and riparian habitat under alternative 4. While individual animals could be impacted by the actions under this alternative, the alternative would not lead toward Federal listing of the above sensitive species. Beneficial impacts include a slight to moderate improvement in potentially suitable habitat in riparian and aquatic habitat within Wetland Jewels and Rio Grande Cutthroat Trout Management Areas. Improvements to forestwide riparian and aquatic habitat would be at a slower rate and intensity than other action alternatives.

Summary of All Alternatives for Regional Forester's Sensitive Species

All alternatives would maintain viability of sensitive species (within the authority of the Forest Service); however, the rate and magnitude of change to wildlife ecological condition varies.

Alternative 1 is limited in terms of its ability to positively affect species viability because it lacks clear desired conditions and guidelines developed using the best available science; it does not reflect the most current advances in scientific understanding and changes in social, economic, and ecological conditions that have occurred since it was signed, and it is the least able to adapt to changing conditions. Alternative 1 also lacks forestwide language that directly addresses the significant threats of disease and invasive, nonnative animals, connectivity, altered hydrology, and restricted and endemic species that are naturally rare. Overall, this alternative would realize the least amount of restoration progress for the most wildlife species compared to the other alternatives. At best, species viability would be maintained but ecosystem recovery would be on a slower trajectory than for the action alternatives for most species.

Alternative 3 focuses on forest products and increased human use. This alternative has more clearly-defined plan components than alternative 1 to better address wildlife species needs at multiple spatial scales. Under this alternative, species are generally protected through specific vegetation community, watershed, and management area direction. However, in some cases there is additional species-specific direction that provides even more emphasis and protection for sensitive species. Alternative 3 has the greatest ability for maintaining species persistence over time for the majority of species. This alternative, with increased mechanical treatment, would move departed ecological condition of frequent fire forest toward desired condition the fastest. However, the increased mechanical treatment, potential to increase road use, and the inclusion of off-highway vehicle management area would have the greatest increase in

ground disturbance. Watershed conditions would be worse compared to alternative 2, with cascading impacts on riparian function, thereby negatively impacting riparian and aquatic sensitive species.

Alternatives 2 and 4 would move ecological condition toward desired conditions faster than alternative 1. However, alternative 4 would move riparian and aquatic ecological conditions toward the desired condition at a slower rate than alternatives 2 or 3 because restoration overall would be slightly less effective. Alternative 4 would also have the highest negative impact from uncharacteristic, stand-replacing wildfire. Both alternatives would include the same forestwide plan components for sensitive species as alternative 3.

Alternatives 4 and 5 proposed more recommended wilderness than alternatives 2 and 3, which would benefit some species in the short term. However, the forest would be limited to naturally ignited wildfire managed for resource benefit in these areas. As a result, the net positive impacts from these additions on wildlife would be counterbalanced by the potentially negative effects that could result from large, stand-replacing wildfire.

Table 44. Estimated change in potential habitat for sensitive species that use frequent fire forest (ponderosa pine and mixed conifer frequent fire)

Species	Current acres	Alternative 1 acres	Alternative 2 acres	Alternative 3 acres	Alternative 4 acres	Alternative 5 acres
Northern goshawk	93,425	226,429	269,396	314,393	231,848	269,396
American peregrine falcon, bald eagle, pale Townsend's big-eared bat, spotted bat, and Ripley's milkvetch	67,984	97,010	208,472	282,158	184,741	208,472

Migratory Birds and Golden and Bald Eagles

New Mexico Partners in Flight identifies physiographic areas and high priority migratory bird species by broad habitat types. They also develop a list of priority breeding bird species by habitat type. The U.S. Fish and Wildlife Service released its Birds of Conservation Concern 2008 report (USDI FWS 2008), and the Carson is part of Bird Conservation Region 16 and has a couple of important bird areas. Those migratory birds that occur within Carson habitats are analyzed. The Migratory Bird Treaty Act of 1918 (16 U.S.C. 703-712; Ch. 128; July 3, 1918; 40 Stat. 755) prohibits the “taking” and “killing” of migratory birds. “Incidental take” is take that results from an activity but is not the purpose of that activity. This interpretation was recently reviewed (USDI FWS 2018) and the conclusion was that the statute's prohibitions on pursuing, hunting, taking, capturing, killing, or attempting to do the same apply only to affirmative actions that have as their explicit purpose “the taking or killing of migratory birds, their nests, or their eggs” (e.g., hunting and poaching).

Golden eagles are known to nest on some location of the Carson. Bald eagles, however, are not known to nest on the Carson, but rather just use the forest for occasional foraging. The forest lacks large bodies of water with adequate prey species for bald eagle. The agency is required by law to protect golden eagle in accordance with the Bald and Golden Eagle Protection Act (16 U.S.C. 668-668c).

All migratory birds and eagles listed in table 45 were evaluated when developing the list for species of conservation concern. More information about the Carson species of conservation concern selection process can be found on the [Species of Conservation Concern webpage](#) for the Carson. Some migratory birds were included as species of conservation concern and are analyzed in the section for [species of](#)

[conservation concern](#). These migratory birds include burrowing owl, pinyon jay, and peregrine falcon. southwestern willow flycatcher and western yellow-billed cuckoo are analyzed as [federally listed species](#).

Environmental Consequences for Migratory Birds and Golden and Bald Eagles

Environmental Consequences for Migratory Birds and Golden and Bald Eagles Common to All Alternatives

Probable management activities that could potentially affect wildlife communities can be grouped into three broad categories: (1) changes in the type, quantity, quality, and spatial arrangement of suitable habitat; (2) direct mortality, reduced survival, or increased susceptibility to mortality; and, (3) increased disturbance.

There would be no programmatic take under the Bald and Golden Eagle Protection Act. Golden eagle nest on cliffs and rocky features within the Carson. Cliffs and rock features are widespread microsites within all vegetation communities. These ecological conditions are inherently stable for long periods of time because they are changed primarily by geologic forces. Bald eagle use on the forest is foraging and migration and winter use with no known established winter roost sites. In general, the Carson does not have the large lakes and bodies of water needed for bald eagle foraging and breeding. The plan revision process addressed the needs of migratory birds and eagles by considering the habitat upon which these birds depend during the development of plan components for the action alternatives. Such considerations are already in place under alternative 1. Migratory birds are ubiquitous and use numerous habitat types across a range of elevations and restoration of many vegetation types at various elevations would benefit habitat for migratory bird species, especially in cases where restoration focuses on moving the vegetation toward the natural range of variation, improving resilience to wildfire and changing climate conditions, protecting and restoring riparian and watershed conditions, and controlling or eradicating invasive species.

Under all alternatives, important bird areas would not be impacted by management activities. These important bird areas include the Chama River Gorge and the Upper Rio Grande Gorge. The Chama River Gorge Important Bird Area is within a designated wilderness, which limits management activities. The Upper Rio Grande Gorge Important Bird Area is within a very steep canyon where very little management activities (mostly hiking) take place.

Ecological Condition

All five alternatives would use mechanical vegetation treatment and wildfire to manage frequent fire forest (e.g., ponderosa pine and dry mixed conifer) and mechanical vegetation treatment or structural improvement to manage riparian/water resources (e.g., aquatics and forested riparian) to improve ecological condition, abundance, and distribution for species that depend on those vegetation communities. These systems are all highly departed from reference conditions. Current science demonstrates the positive benefits that forest fuel-reduction treatments can have in terms of improving resiliency in frequent fire adapted systems of the west/southwest (Stephens et al. 2012). Conditions and trends in the other vegetation communities did not raise significant concerns, therefore no objectives were developed for them. The Carson has, however, identified desired conditions for these other vegetation communities and would implement management to make progress toward desired conditions as capacity allows.

For migratory bird species and eagles that use frequent fire forests (dry mixed conifer and ponderosa pine), riparian (wetlands and forested riparian), and aquatic systems, the primary contemporary threat is loss of habitat related to large, stand-replacing wildfire, associated runoff and sedimentation that could affect riparian habitat, and reduced in-stream flow. All alternatives would move ecological condition for

these species toward the desired state but vary in magnitude, intensity, and location of treatments. There could be some localized adverse impacts to these species, however, in the long term, beneficial impacts include a slight improvement in potentially suitable ecological condition in frequent fire forests, riparian, and aquatic systems by increasing the amount of habitat in the desired seral states or properly functioning condition for breeding, roosting, and foraging. Objectives to treat acres in these departed systems would move those systems toward a vegetative or aquatic state more complementary to those species' evolution.

Table 45. Migratory birds and primary habitat needs

Migratory Bird Common and Scientific Name	Vegetation Systems / Communities	Important Habitat Feature
American dipper <i>Cinclus mexicanus</i>	Cliffs and Rocky Features; Aquatic / Streams; Riparian / Wetland Riparian and Forest and Shrub Riparian	Cliffs or rocky crevices near clear fast-moving streams
Bald Eagle <i>Haliaeetus leucocephalus</i>	Riparian / Waterbodies and Forest and Shrub Riparian; Aquatic / Waterbodies; Frequent Fire Forest/ Mixed Conifer with Frequent Fire and Ponderosa Pine Forest	The forest lacks large bodies of water with adequate prey species for Bald eagle, but will find them foraging during the winter
Black Rosy-finch <i>Leucosticte atrata</i>	Cliffs and Rocky features; Non-forest / Alpine and Tundra; High Elevation Forest / Spruce-Fir Forest	Only winter on the Carson. Caves or cliff (crevices) are important night roost. In winter, feeds in Alpine Tundra or open Spruce-Fir Forest
Black swift <i>Cypseloides niger</i>	Aquatic / Streams; Cliffs and Rocky Features / Cliffs and Rocky Features	Nests on ledges or shallow caves in steep rock faces and canyons, usually near or behind waterfalls
Black-throated gray warbler <i>Setophaga nigrescens</i>	Woodland / Piñon-Juniper Woodland and Piñon-Juniper Sagebrush	Large dense piñon dominated woodlands
Brewer's Sparrow <i>Spizella breweri</i>	Non-forested/ Sagebrush	Landscapes dominated by big sagebrush
Brown-capped Rosy- finch <i>Leucosticte australis</i>	Non-forest/ Alpine and Tundra; High Elevation Forest/ Spruce-Fir Forest; Cliff and Rocky Features	Uses cirque headwalls, talus slopes and permanent or late- melting snowfields
Burrowing Owl <i>Athene cunicularia</i>	Non-forest/ Montane Subalpine Grassland and Sagebrush	Nest and roost in recently abandoned burrows dug by mammals within grasslands and sagebrush
Cassin's finch <i>Haemorhous cassinii</i>	Frequent Fire Forest/ Ponderosa Pine Forest and Mixed Conifer with Frequent Fire	Open coniferous forest
Chestnut-collared longspur <i>Calcarius ornatus</i>	Non-forested/ Montane Subalpine Grassland	Desert grasslands dominated by low grasses and forbs
Dusky flycatcher <i>Empidonax oberholseri</i>	Frequent Fire Forest/ Mixed Conifer with Frequent Fire	Mixed conifer forest with a shrubby understory. Uses early succession habitat following a disturbance, such as fire
Dusky grouse <i>Dendragapus obscurus</i>	High Elevation Forest/ Bristlecone Pine, Spruce-fir Forest, and Mixed Conifer with Frequent Fire	Open tree canopies
Flammulated owl <i>Psiloscops flammeolus</i>	Frequent Fire Forest/ Ponderosa Pine Forest	Secondary cavity nester in open Ponderosa Pine Forest

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Migratory Bird Common and Scientific Name	Vegetation Systems / Communities	Important Habitat Feature
Golden eagle <i>Aquila chrysaetos</i>	All Habitat Types/ Alpine and Tundra, Bristlecone Pine, Spruce-fir Forest, Montane Subalpine Grassland, Mixed Conifer with Aspen, Ponderosa Pine Forest, Mixed Conifer with Frequent Fire, Piñon-Juniper Woodland, Piñon-Juniper Sagebrush, Sagebrush, Wetland Riparian, Forest and Shrub Riparian, Streams, Waterbodies, Cliffs and Rocky Features	Breed and forages in open to semi-open habitats
Grace's warbler <i>Dendroica graciae</i>	Frequent Fire Forest/ Ponderosa Pine Forest	Open, old-growth forest
Gray flycatcher <i>Empidonax wrightii</i>	Woodlands/ Piñon-Juniper Woodland	Low shrub understory
Gray vireo <i>Vireo vicinior</i>	Woodlands/ Piñon-Juniper Woodland and Piñon-Juniper Sagebrush	Prefers open woodlands
Green-tailed towhee <i>Pipilo chlorurus</i>	Frequent Fire Forest/ Ponderosa Pine Forest and Mixed Conifer with Frequent Fire; Woodlands/ Piñon-Juniper Woodland, Piñon-Juniper Sagebrush; Non-forest/ Sagebrush	Desert grasslands dominated by low grasses and forbs
Hammond's flycatcher <i>Empidonax hammondi</i>	High Elevation Forest/ Spruce-fir Forest and Mixed Conifer with Aspen	Dense forest near timberline
Juniper titmouse <i>Baeolophus ridgwayi</i>	Woodland/ Piñon-Juniper Woodland, Piñon-Juniper Sagebrush	Open juniper dominates woodlands with large trees
Lewis's woodpecker <i>Melanerpes lewis</i>	Frequent Fire Forest/ Ponderosa Pine Forest; Riparian/ Forest and Shrub Riparian	Open Ponderosa Pine Forest with large trees or riparian with large cottonwoods.
Long-eared owl <i>Asio otus</i>	High Elevation Forest/ Spruce-fir Forest and Mixed Conifer with Aspen; Frequent Fire Forest/ Ponderosa Pine Forest and Mixed Conifer with Frequent Fire	Inhabits dense forest adjacent to grasslands or shrublands.
MacGillivray's warbler <i>Geothlypis tolmiei</i>	High Elevation Forest/ Spruce-fir Forest and Mixed Conifer with Aspen	Disturbed coniferous forest
Mountain plover <i>Charadrius montanus</i>	Non-forest/ Montane Subalpine Grassland	Large, flat grassland expanses with sparse, short vegetation, and bare ground
Olive-sided flycatcher <i>Contopus cooperi</i>	Frequent Fire Forest/ Ponderosa pine forest and Mixed Conifer with Frequent Fire; High Elevation Forest/ Spruce-fir Forest and Mixed Conifer with Aspen	Needs snags or treetops near open areas, forest edges, or above canopy as diet consists mainly of larger flying insects.
Pinyon jay <i>Gymnorhinus cyanocephalus</i>	Woodlands/ Piñon-Juniper Woodland and Piñon-Juniper Sagebrush	Large stands of piñon pine with large pine nut producing trees
Prairie falcon <i>Falco mexicanus</i>	Non-forest/ Montane Subalpine Grassland; Cliffs and Rocky Features/	Inhabits open grassland near cliffs and outcrops
Peregrine falcon <i>Falco peregrinus</i>	All Vegetation Systems/ Alpine and Tundra, Montana Subalpine Grassland, Sagebrush, Spruce-fir Forest, Mixed Conifer with Aspen, Mixed Conifer with Frequent Fire, Ponderosa pine forest, Piñon-Juniper Woodland and Piñon-Juniper Sagebrush, Wetland Riparian, Forest and Shrub Riparian, Cliffs and Rocky Features, Waterbodies	Nests are constructed on ledges on relatively tall cliffs, in remote areas

Migratory Bird Common and Scientific Name	Vegetation Systems / Communities	Important Habitat Feature
Red-naped sapsucker <i>Sphyrapicus nuchalis</i>	High Elevation Forest/ Spruce-fir Forest and Mixed Conifer with Aspen; Frequent Fire Forest/ Ponderosa Pine Forest and Mixed Conifer with Frequent Fire; Woodlands/ Piñon-Juniper Woodland	Aspens and snags are highly favored for nest locations.
Rufous hummingbird <i>Selasphorus rufus</i>	Non-forest/ Montane Subalpine Grassland	Mountain meadows and disturbed areas with nectar standing crops
Sagebrush sparrow <i>Artemisiospiza nevadensis</i>	Non-forest/ Sagebrush	Prefer taller shrubs with larger canopies
Sage thrasher <i>Oreoscoptes montanus</i>	Non-forest/ Sagebrush	Big sagebrush dominated
Veery <i>Catharus fuscescens salicicola</i>	Riparian/ Forest and Shrub Riparian	Riparian forest with a dense understory
Virginia's warbler <i>Vermivora virginiae</i>	Frequent Fire Forest/ Ponderosa Pine Forest	Open ponderosa pine forest with dense shrub understory
Willet <i>Tringa semipalmata</i>	Riparian/ Wetland Riparian	Marsh habitat
Williamson's sapsucker <i>Sphyrapicus thyroideus</i>	Frequent Fire Forest/ Ponderosa Pine Forest and Mixed Conifer with Frequent Fire; High Elevation Forest/ Spruce-fir Forest and Mixed Conifer with Aspen	Mid- to high-elevation coniferous forests and mixed deciduous/ conifer forests. Aspen is an important nesting substrate.
Southwestern willow flycatcher <i>Empidonax trailii</i>	Riparian/ Forest and Shrub Riparian	Dense riparian habitat with willow, salt cedar, or cottonwood
Western yellow-billed cuckoo <i>Coccyzus americanus</i>	Riparian/ Forest and Shrub Riparian	Prefer mature or late-successional cottonwood/willow associations with a dense understory

Eligible Wild and Scenic Rivers

A comprehensive evaluation of wild and scenic rivers was conducted as part of the plan revision process, which resulted in 51 eligible wild and scenic river segments on the forest. This would have potentially beneficial impacts by limiting the types of instream infrastructure. Limiting the types of instream infrastructure would provide habitat connectivity and minimize ground disturbance on migratory bird and eagle species that use riparian and aquatic habitat.

Designated Wilderness and Inventoried Roadless Areas

Designated wilderness (129,119 acres) and inventoried roadless (105,000 acres) areas provide beneficial impact for habitat connectivity and minimize disturbance to migratory birds and eagles through primitive management or lack of road construction.

Developed Winter and Summer Resort Management Area

The Developed Winter and Summer Resort Management Area comprises the permitted ski areas on the Carson. Under the 1986 Forest Plan, as amended, this management area is currently in an altered vegetative state from reference condition and would continue to be managed as such under all alternatives. This management area would increase ground disturbance from ski area development and increase human intrusive disturbance to migratory birds and eagle that use this management area under all

alternatives. The substantive difference among alternatives for the Developed Winter and Summer Resort Management Area is under alternative 3, the management area is expanded by 921 acres around the Sipapu Ski and Summer Resort. The current Sipapu permitted boundary is 215 acres and would remain this acreage under all alternatives except alternative 3 where it would likely be expanded through a separate analysis. The effect of this change is discussed in Environmental Consequences – Alternative 3.

Climate Change

Climate change has occurred to some degree and will continue in the future. Ramifications of a changing climate on wildlife are likely to include reduced snowfall or earlier snow melt in the spring, extended periods of drought or extended dry periods in the spring and summer, more frequent and larger wildfires, increased insect and disease induced mortality, and changes in site characteristics that promote type conversion or vegetation community changes. This pattern is consistent with current trends in other parts of the West (Fettig et al. 2013).

These changes cause seasonal ranges and food sources for wildlife to shift and can affect the timing of reproduction. Reduced snowpack and changes in precipitation can affect amphibians by reducing water levels in lakes and ponds and can affect species that rely on deep or persistent snow. Forested tracts and remote habitats can also become isolated, reducing landscape connectivity and ecological condition for species with limited dispersal ability. The timing of spring green up can also affect food availability for migratory birds and eagles. Those species with highly specialized ecological condition requirements, at the edge of their range, currently in decline, and/or having poor dispersal abilities may be particularly at risk (National Fish Wildlife and Plants Climate Adaptation Partnership 2012).

Climate change presents an aspect of uncertainty in future conditions, disturbance regimes, and vegetative and wildlife responses. Strategies that can be used to help reduce impacts from climate change include managing for diverse conditions, maintaining healthy and connected populations, reducing the risk of large uncharacteristic fire, preventing and controlling invasive species, and ensuring ecosystem processes and habitat connectivity (The Heinz Center 2008). While how well each of the alternatives address these strategies varies, it is assumed that to a certain extent, climate change and associated effects to wildlife would occur under all alternatives. The Climate Vulnerability Assessment for the Carson (USDA FS 2014a) provides additional information on the vulnerability of the different vegetation communities and habitat types to climate change.

Environmental Consequences for Migratory Birds and Golden and Bald Eagles – Alternative 1

The existing 1986 Forest Plan, as amended, was developed under the 1982 planning rule and considerations for migratory birds and eagles are already in place under alternative 1. However, alternative 1 does not include desired conditions for every ecological condition needed by individual migratory bird species.

The key ecological conditions and the key threats affecting those conditions are described below for all action alternatives, which follows this section. Because the existing 1986 Forest Plan, as amended, was not explicitly developed using the coarse-filter, fine-filter approach (a key tenet of the species diversity requirements under the 2012 rule), alternative 1 would be largely limited to plan direction from the 1996 amendment, best management practices, and site-specific mitigations done at the project level.

The 1986 Forest Plan, as amended, lacks a description of desired conditions for many of the key ecological characteristics, making it harder to ensure projects are implemented in a consistent manner and that projects are moving toward a common set of desired conditions and long-term goals. The current 1986 Forest Plan, as amended, does not define specific desired fire regimes or contain objectives for frequency of fire to maintain or improve stand structure, maintain or decrease fuel loads, or to achieve other resource benefits. With the continued lack of fire disturbance, the risk of losing Frequent Fire Forest

vegetation systems to stand-replacing wildfire and the resulting uncharacteristic open state increases over time.

The potential loss of ecological condition components due to large, high-severity wildfires could have particularly negative effects on habitat used by migratory birds species like bald eagle, Cassin's finch, dusky flycatcher, flammulated owl, golden eagle, Grace's warbler, green-tailed towhee, Lewis's woodpecker, long-eared owl, olive-sided flycatcher, peregrine falcon, red-naped sapsucker, Virginia's warbler, and William's sapsucker. Frequent fire forest, riparian, and aquatic systems are highly departed and trending away from reference conditions, this trend would continue. Alternative 1 would continue to maintain current rates of planned and unplanned natural ignition and mechanical vegetation treatment, which would move those vegetation states toward desired conditions at a slower rate than any of the action alternatives for migratory birds that use frequent fire forest.

Most of the standards and guidelines that have the potential to benefit migratory bird and eagles in the current 1986 Forest Plan, as amended, are also found in the action alternatives in the form of desired conditions, guidelines, or management approaches. In many places, the current 1986 Forest Plan, as amended, reiterates existing law, regulation, or policy, but these are incorporated by reference in the action alternatives and are considered more specifically at the project level. The forest would continue to follow existing law, regulation, policy, and best management practices to address migratory birds and eagles in areas affected by large-scale disturbance.

There is no recommended wilderness under alternative 1.

Summary

In summary, alternative 1 has general direction to protect migratory birds and eagles, however, plan direction is based on outputs rather than outcomes and fails to address current scientific thinking on the use of wildland fire and vegetation management as a way to promote ecological integrity, resilience, and wildlife diversity. Projects and activities would be guided by agency direction for managing federally listed species and direction to manage regional forester's sensitive species.

Environmental Consequences for Migratory Birds and Golden and Bald Eagles Common to Alternatives 2, 3, 4, and 5

Action alternatives 2, 3, 4, and 5 are more strategic in nature and integrated than the current 1986 Forest Plan, as amended (alternative 1). All action alternatives include plan direction designed to maintain the diversity of plant and animal communities and support habitat utilized by migratory bird and eagles within the plan area, subject to the extent of Forest Service authority and the inherent capability of the plan area.

Substantive differences among action alternatives include six place-based management areas, each having their own set of plan components. Other substantive differences between action alternatives that could impact habitat utilized by migratory birds and eagles include the amount of recommended wilderness being proposed, the role of mechanical treatments and wildland fire as restoration tools, the amount of riparian/aquatic systems restored, and the amount of roads maintained or decommissioned for ecosystem health. Current science recognizes both wildland fire and vegetation management as tools through which ecological integrity and resilience can be managed (C. Miller and Aplet 2016; Reynolds et al. 2013). The action alternatives more proactively incorporates this thinking. All action alternatives would provide for a substantial increase in both prescribed fire and unplanned natural ignitions that are managed for resource benefits. This would have positive effects for migratory bird species and eagles that use frequent fire forest, riparian, and aquatic systems by decreasing the chance for stand-replacing fires and thereby decreasing sedimentation from fire flood events. The action alternatives also make better use of partnerships and collaboration to maintain ecosystem integrity and resilience. Current science suggests

that conservation partnerships are becoming increasingly important to adaptively manage for climate change (Monahan and Theobald 2018).

Adaptive management will be essential to effectively manage for climate change and associated impacts from disturbance events and invasive species in changing and uncertain conditions. As a result, the action alternatives include a monitoring plan designed to better inform the effects and effectiveness of management and progress toward desired conditions. Action alternatives 2, 3, 4, and 5 better recognize and address the negative effects nonnative invasive species and disease can have on ecosystem integrity and biological diversity. Direction for invasive species was updated and expanded to recognize the threats to ecosystem resilience from all nonnative, invasive, aquatic and terrestrial plants and animals likely to cause harm to ecosystems. The action alternatives recognize and include plan components to help address these threats and to reduce the risk of removing ecological condition for migratory birds and eagles.

Recommended wilderness is proposed under alternatives 2, 4, and 5 (table 36). Recommended wilderness beneficially affects migratory birds and eagles through its primitive management, which minimizes disturbance and provides habitat connectivity. However, the Carson would also be more limited in its ability to treat these areas and would rely on wildland fire as its main restoration tool. Limiting the ability to treat these areas may leave these areas vulnerable to large, stand-replacing wildfire and cause these areas to become more departed in the future. More departed ecological conditions in the future may negatively affect migratory birds and eagles dependent on this habitat by altering seral state conditions. Alternative 2 identifies 9,189 acres for recommended wilderness, alternative 4 includes 45,473 acres for recommended wilderness, and alternative 5 would include the most recommended wilderness (67,996 acres).

Explicit forestwide plan direction that includes beneficial language to mitigate negative impacts on migratory birds and eagles, in general, for climate change, nonnative invasive species, disease, and connectivity, which are missing from alternative 1, include but are not limited to plan components found in table 37 to table 39 of the Federally Listed Species section.

These plan components would be beneficial for all migratory birds and eagles but especially those species that depend on riparian systems, frequent-fire adapted ecosystems, aquatic systems, and species that move across large landscapes and use habitat at multiple spatial scales. These plan components would benefit migratory birds and eagles by supporting resilient and resistant ecosystems and watersheds, which would protect species from the negative effects of climate change and would give wildlife species the best opportunity to adapt to changing conditions. This type of plan language, which can be found in the action alternatives, is not explicitly called out under alternative 1 and should have a more positive effect.

All Forested Ecosystems including Frequent Fire Forest

(BP, SFF, MCW, MCD, PPF, PJO, PJS): Bald eagle, black rosy-finch, black-throated gray warbler, brown-capped rosy-finch, Cassin's finch, dusky flycatcher, dusky grouse, flammulated owl, golden eagle, Grace's warbler, gray flycatcher, gray vireo, green-tailed towhee, Hammond's flycatcher, juniper titmouse, Lewis's woodpecker, long-eared owl, McGillivray's warbler, olive-sided flycatcher, pinyon jay, peregrine falcon, red-naped sapsucker, Virginia's warbler, and William's sapsucker

These species would benefit primarily from objectives that move highly departed frequent fire forest toward a more desired state. The objectives and effects differ across the action alternatives and the total amount of ecological condition moved toward desired conditions over the 15-year life of the plan varies across alternatives. The differing amounts of ecological condition improved are highlighted in the individual sections for each alternative in their respective vegetation sections. High-elevation forest and woodlands are only low to moderately departed from reference conditions, as such, objectives were not identified for these systems under the action alternatives.

Plan components that would benefit migratory birds and eagles that depend on Forested Ecosystems include desired conditions to maintain appropriate structure, composition, and function at the landscape (1,000 to 10,000 acres or more), mid (100 to 1,000 acres) and fine scales (less than 10 acres). Forests that have departed structure also have departed fire regime condition class. Restoring vegetation structure in frequent fire forest through vegetation management and fuels reduction projects will improve fire regime condition class and reduce the risk of stand-replacing fire. Desired conditions that incorporate varying structural stages, including uneven-aged forest with openings, occasional even-aged structure with large snags and abundant understory (e.g., coarse woody debris, logs), and old-growth components would guide the implementation of forest management activities that would move frequent fire forest toward a more favorable departure and trend from that which currently exists. The full range of life stage needs for migratory birds and eagles (e.g., fledging, nesting, dispersal, roosting), as well as conditions that would support an adequate prey base for foraging are provided for at the landscape (FW-VEG-MCD-DC 1-2, 4, FW-VEG-PPF-DC 1-2, FW-VEG-PPF-DC 4-7); mid (FW-VEG-MCD-DC 8-12, FW-VEG-PPF-DC 8-10); and fine scales (FW-VEG-MCD-DC 16, 18, and 19, FW-VEG-PPF-DC 15-18, FW-VEG-SFF-G 2-4, FW-VEG-ASP-G 3, FW-VEG-MCW-G 3-5, FW-VEG-MCD-G 3-5, and FW-VEG-PPF-G 5-7).

Although there are no objectives identified for high elevation forest or woodlands, desired conditions would ensure appropriate composition, structure, and function are accounted for and provide for life stage needs of migratory birds and eagles at the landscape (FW-VEG-BP-DC 1, FW-VEG-SFF-DC 1-2, 4, FW-VEG-MCW-DC 1-2, FW-VEG-MCW-DC 4-6, FW-VEG-PJO-DC 1-3, FW-VEG-PJO-DC 7-8, FW-VEG-PJS-DC 1-2, FW-VEG-PJS-DC 7-8); mid (FW-VEG-BP-DC 6-7, FW-VEG-SFF-DC 8-9 and 14, FW-VEG-MCW-DC 8-12, FW-VEG-PJO-DC 9-10, FW-VEG-PJS-DC 9-10); and fine scales (FW-VEG-SFF-DC 15, FW-VEG-MCW-DC 15, FW-VEG-PJO-DC 13, FW-VEG-PJS-DC 15).

Additional plan components under the wildland fire management resource area promote endemic levels of disturbance, natural fire regimes, and restoration activities that would allow all forest ecosystems to be resilient in the face of climate change, drought, and other disturbance. These include (FW-FIRE-DC 1-2; FW-FIRE-G 1, 3, 7). A forestwide component specific to disturbances and climate change in the all Vegetation section (FW-VEG-DC 2) further supports ecosystem resiliency.

The sustainable forestry and forest products resource area would ensure that private and commercial timber harvest is used as a restoration tool and desired conditions for this resource (FW-FFP-DC 4-5) would ensure these types of activities are done in a way that enhances wildlife and aquatic ecological condition. Within this section are vegetation management standards (FW-FFP-S 1 and 2) that would mitigate habitat disturbance and damage that might occur as a result of timber harvest, so that watershed conditions are protected, and the ecological needs of migratory birds and eagles are maintained.

The following plan components, in addition to the ones stated above, would ensure protective measure are included for migratory birds and eagles that utilize forested ecosystems during project design:

- FW-VEG-G 3 Vegetation should provide for at-risk species' habitats by minimizing disturbance, providing recovery strategies, and managing for desired levels of key structural elements (e.g., large old trees and snags, downed woody debris, denser vegetation structure, and soil structure) important for nesting, rearing, breeding, foraging, dispersal, and other life history needs, to maintain the persistence or contribute to the recovery of at-risk species.
- FW-WFP-G 3 Management activities should avoid disturbance at known active raptor nests and fledging areas, to maintain the persistence or contribute to the recovery of at-risk species. Timing restrictions, adaptive percent utilizations, distance buffers, or other means of avoiding disturbance

should be based on the best available scientific information, as well as on site-specific factors (e.g., topography and available habitat).⁸

- FW-VEG-PJO-G 1 and PJS-G 4 Treatments in PJO should leave key habitat features (i.e., roosting trees, snags, partially dead or dying trees, large trees, or downed logs) and single or small groups of medium to large native trees that are widely spaced, with expanses of herbaceous vegetation and coarse woody debris, to provide for soil productivity, traditional uses (e.g., piñon nut gathering), and wildlife needs, such as foraging habitat for at-risk species, migratory birds, and other piñon-juniper obligate species.
- FW-VEG-PJO-G 2 and PJS-G 3 Treatments in PJO should avoid creating a sharp, well-defined edge between dense woodlands and recovered shrublands, to provide foraging habitat of at-risk species.

Large trees, Coarse woody debris, and snag associates

(BP, SFF, MCW, MCD, PPF, PJO, PJS, SAGE): Bald eagle, black-throated gray warbler, Grace's warbler, Lewis's woodpecker, pinyon jay, olive-sided flycatcher, and red-naped sapsucker

Many of the migratory birds and eagle species that need diverse forest structure and old-growth components are also dependent on large trees, coarse woody debris, snags, and tree-related components for roosting, foraging, and nesting. Downed woody material and logs provide important ecological condition for small mammalian prey species. In addition to the components described above, these species would also benefit from several ecosystem-level plan components which would protect these key ecological conditions.

Plan components that would benefit the majority of migratory birds and eagle species that depend on these vegetation communities include desired conditions to maintain appropriate levels of old trees, snags, and downed wood at multiple spatial scales. Forestwide desired conditions for the different vegetation community include the landscape (FW-VEG-DC 1-4; FW-VEG-SFF-DC 3-4; FW-VEG-MCW-DC 4-6; FW-VEG-MCD-DC 4-6; FW-VEG-PPF-DC 5-8) and midscale (FW-VEG-SFF-DC 8-9; FW-VEG-MCD 13; FW-VEG-PPF-DC 10).

Forestwide components for All Vegetation communities include guidelines that would leave adequate numbers of snags, large trees, and coarse woody material (FW-VEG-G 3 and 4). There are also plan components that balance the needs of multiple use with migratory birds and eagles that need large trees and snags (FW-REC-G 1). Guideline 1 in Recreation would minimize impacts to these habitat features in developed and dispersed recreation sites. Ponderosa Pine includes guideline FW-VEG-PPF-G 1, that vegetation treatments should be designed to assure continuous recruitment of old-growth characteristics across the landscape over time. Guidelines within soil, vegetation, and fire (FW-SL-DC 1-2, FW-SL-G 1, FW-VEG-SFF-G 1, FW-FIRE-G 9) would ensure sufficient levels of woody debris are maintained during projects and would mitigate negative effects that occur from ground-disturbing activities and prescribed burns that cause soil loss, erosion, compaction, and scarification.

Migratory birds that use piñon-juniper, particularly tree components including large, old trees and snags for roosting, nesting and foraging, would benefit from landscape-scale desired conditions that promote heterogeneity and old-growth components in piñon-juniper woodland and piñon-juniper sagebrush (FW-PJO-DC 1-3, FW-PJO-DC 7-8, PW-PJS-DC 1, and FW-PJS-DC 7-8). Since fuelwood removal can deplete these components on the landscape, Sustainable Forestry and Forest Products has a desired condition that would minimize the harvest of these ecological elements (FW-FFP-DC 4-5). This desired condition would mitigate this threat by ensuring private and commercial timber harvest enhances and supports wildlife ecological condition, particularly with regard to snags and dying trees.

⁸ Birds known to have established nests near preexisting human activities are assumed to be tolerant of the level of activity present when the nest was established.

The following plan components, in addition to the ones stated above, would ensure protective measure are included for migratory birds and eagles that rely on large trees, snags and coarse woody debris during project design:

- FW-VEG-PPF-G 1 Vegetation treatments should be designed such that structural stages and age classes are proportionally represented to assure continuous recruitment of old-growth characteristics across the landscape over time.
- FW-VEG-MCW-G 1, MCD-G 1, and PPF-G 3 Slash piles should be retained across the landscape for several years, to increase small mammal occupancy in areas where coarse woody debris is deficient and provide nesting habitat and cover for associated wildlife species (e.g., turkeys, birds, small mammals, reptiles, and invertebrates).
- FW-VEG-PJO-G 1 and PJS-G 4 Treatments in PJO should leave key habitat features (i.e., roosting trees, snags, partially dead or dying trees, large trees, or downed logs) and single or small groups of medium to large native trees that are widely spaced, with expanses of herbaceous vegetation and coarse woody debris, to provide for soil productivity, traditional uses (e.g., piñon nut gathering), and wildlife needs, such as foraging habitat for at-risk species, migratory birds, and other Piñon-Juniper obligate species.
- FW-VEG-PJO-G 2 and PJS-G 3 Treatments in PJO should avoid creating a sharp, well-defined edge between dense woodlands and recovered shrublands, to provide foraging habitat of at-risk species.

Non-forested Vegetation System Associates

(ALP, MSG, and SAGE): American peregrine falcon, burrowing owl, black rosy-finch, Brewer's sparrow, brown-capped rosy-finch, chestnut-collared longspur, golden eagle, green-tailed towhee, mountain plover, prairie falcon, rufous hummingbird, sagebrush sparrow, and sage thrasher

Maintaining habitat for migratory birds and eagles that use non-forested vegetation system is largely realized through desired conditions for Sagebrush (SAGE), Montane and Subalpine Grassland (MSG), Alpine Tundra (ALP), Wildlife, Fish, and Plants (WFP), Recreation (trails), Sustainable Rangeland and Livestock Grazing (GRZ), and Sustainable Forestry and Forest Products (FFP) resource areas.

The full range of life stage needs for migratory birds and eagles (e.g., fledging, nesting, dispersal, roosting), as well as conditions that would support an adequate prey base for foraging are provided for at the landscape (FW-VEG-ALP-DC 1-2; FW-VEG-ALP DC 6-8; FW-VEG-MSG-DC 1-3; FW-VEG-SAGE-DC 1-3); mid (FW-VEG-MSG-DC 10-11); and fine scales (FW-VEG-MSG-DC 14).

Desired conditions for sagebrush (FW-VEG-SAGE-DC 1-3) would ensure enough shrub cover exists for sagebrush obligate species. While desired conditions (FW-VEG-ALP-DC 1 and 5, FW-VEG-MSG-DC 1, 6, and 9) would maintain appropriate seral states and fire regimes within montane subalpine grassland and alpine and tundra.

Sustainable Rangeland and Livestock Grazing Plan components (FW-GRZ-DC 4-5, FW-GRZ-S 1, FW-GRZ-G 5) would ensure livestock grazing is compatible with migratory bird and eagle needs, that shrubs and forbs are available, and that grasslands provide adequate cover to sustain prey-based species. Migratory birds and eagles that use non-forested ecosystems would also benefit from plan components under the Soils section. Standards and guidelines for soils would mitigate negative effects that occur from ground-disturbing activities such as livestock grazing and recreation that cause soil loss, erosion, compaction and (FW-SL-G 1-2; FW-VEG-MSG-S 1; FW-VEG-MSG-G 1).

The following plan components, in addition to the ones stated above, would ensure protective measure are included for migratory birds and eagles that use non-forested ecosystems during project design:

- FW-VEG-ALP-G 1 Trail construction and maintenance in ALP should minimize disturbance to at-risk plants and to important key habitat features (e.g., rock outcrops, willows, and talus slopes) for at-risk species and other alpine dependent species (e.g., yellow-bellied marmot and American pika), to maintain the persistence of native species.
- FW-VEG-ALP-G 2 To assist breeding and nesting success of at-risk species, adaptive seasonal use or percent utilizations for livestock grazing should be considered and based on the best available scientific information, as well as on site-specific factors (e.g., topography and available habitat).
- FW-REC-G 1 Recreation activities should be compatible with and managed adaptively to minimize impacts to at-risk species and ecological desired conditions, including in riparian management zones (e.g., along streams, around seeps, springs, lakes, and wetlands).

Finally, although the threat from sylvatic plague in prairie dogs and burrowing owls are largely beyond the management authority of the Carson, Management Approach 10 in the Wildlife, Fish, and Plants section was added to encourage collaboration and actions that help maintain range-wide species persistence.

Riparian Associates

(Wetland Riparian and Forest and Shrub Riparian): American dipper, bald eagle, golden eagle, veery, willet, southwestern willow flycatcher, and western yellow-billed cuckoo

Riparian habitat includes wetlands and forested riparian (i.e., willow, cottonwood, and alder) areas surrounding seeps/springs, perennial streams, lakes, and other water features. Riparian habitat occupies a very small portion of the forest and ranges from low- to highly-degraded, depending on elevation. Migratory birds and eagles associated with this type of ecological condition would benefit from plan objectives that move riparian, including wetlands, ecological conditions toward the desired state. The objectives and effects differ across action alternatives and the total amount of ecological condition moved toward desired conditions over the 15-year life of the plan varies for each habitat type across alternatives. The differing amounts of ecological condition improved are highlighted in the individual sections for each alternative in their respective sections.

Plan components that would benefit migratory birds and eagles that depend on these vegetation communities can be found under the Watershed and Water, Riparian Management Zones, Wetland Riparian, Forest and Shrub Riparian, Nonnative Invasive Species, Wildlife, Fish, and Plant, All Vegetation, and Fire and Fuels sections of the action alternatives. Additional plan components which balance multiple use with migratory birds and eagles' needs can be found under the Sustainable Grazing and Livestock Management, Roads, and Mineral and Mining sections.

Desired conditions within the Watershed, Riparian Management Zone, Wetland Riparian, and Forest and Shrub Riparian resource sections (FW-WSW-DC 1-3; FW-WSW-RMZ-DC 1-8; FW-WSW-RMZ-WR-DC 1-3; FW-WSW-RMZ-FSR-DC 1-6) would move these systems toward proper functioning condition, while balancing multiple uses with ecological integrity. These components would help to minimize water diversions and improve hydrologic function, while maintaining systems that are resilient to climate change and associated disturbances such as fire. Watershed Guideline (FW-WSW-G 1) would ensure that best management practices are applied to every site-specific project that has the potential to affect watershed conditions. Several standards and guidelines (FW-WSW-G 2; FW-WSW-RMZ-G 1-4; FW-WSW-RMZ-WR-S 1-3) would mitigate adverse effects from road construction or reconstruction, which can cause sedimentation, and would also rehabilitate in-stream structures, which could improve hydrologic function.

Standards for Sustainable Forestry and Forest Products (FW-FFP-S 1-2) would protect the ecological integrity of watershed conditions by minimizing potentially adverse effects that could cause soil erosion

and sedimentation during timber harvest operations. Plan components for the Sustainable Rangelands and Livestock Grazing, Riparian Management Zones resource (FW-GRZ-DC 4-6; FW-GRZ-S 1, FW-GRZ-G 1-3, 5; FW-WSW-RMZ-G 2, FW-WSW-RMZ-STM-DC 11; FW-WSW-RMZ-WB-DC 6) would ensure associated management activities are compatible with ecological function and supportive of diverse native plant communities, including in wetland and riparian areas/riparian management zones. Several guidelines (FW-GRZ-G 3-5) prevent the construction of new structures in riparian management zones and minimize potentially adverse effects that the construction of such structures may have on soils and hydrologic function of natural springs sources.

Desired condition 1 within the Minerals and Mining resource section would minimize impacts to surface and groundwater resources while facilitating the development of minerals. Guideline FW-FW-WSW-RMZ-G2 under the Riparian Management Zone resource section would protect riparian areas from streambed and flood plain alteration while standards and guidelines for the Transportation and Forest Access and Special Use resource sections (FW-TFA-G 2-4; FW-SU-S 2; FW-SU-G 4) would minimize disturbance (e.g., water flow, sedimentation) from the construction of roads and energy corridors by including mitigations to limit disturbance during project level design.

Nonnative plant species can outcompete native species, causing reduction in suitable habitat and alterations in riparian function, while nonnative invasive animals and pathogens can cause direct mortality and predation. These threats are reduced through plan components in the Nonnative Invasive Species and Wildland Fire Management resource sections of the plan through desired conditions, standards and guidelines (FW-NIS-DC 1; FW-NIS-S 1-2; FW-NIS-G 1, 3, 5-6; FW-FIRE-G 2-3) that minimize impacts to wildlife in riparian areas and would also prevent pathogen transmission.

The following plan components, in addition to the ones stated above, would ensure protective measure are included for migratory birds and eagles that use riparian ecosystems during project design:

- FW-REC-G 3 Recreation facilities and improvements should be designed to minimize human and wildlife conflicts (e.g., bear-proof dumpsters, capped pipe used for fences, survey markers, and signpost, or wildlife egress in plumbing vents).
- FW-FAC-G 2 Facilities and structures should be designed and maintained to minimize impacts to terrestrial and aquatic species (e.g., bear-proof dumpsters, capped pipe used for fences, survey markers, and signpost, or wildlife egress in plumbing vents).
- FW-WSW-RMZ-WR-DC 5, FSR-DC 10 Nectar sources (e.g., thistle, horsemint, and Joe-pye weed) are available for at-risk species.
- FW-WSW-RMZ-FSR-DC 4 Riparian forest vegetation provides nesting and foraging habitat for Neotropical migrant birds, raptors, and cavity-dependent wildlife.
- FW-WSW-RMZ-FSR- DC 12 Dense willow conditions (70 percent cover or greater) are retained for at-risk species habitat.
- FW-WSW-RMZ-FSR- G 1 Connectivity within FSR should be maintained and enhanced by protecting ecological functions, tree density and growth, and native understory, to reduce the risk of predation and parasitism, and to provide habitat for at-risk and other wildlife species.
- FW-WSW-RMZ-FSR- G 3 Large mature cottonwood trees should be protected from management activities that could degrade them as suitable habitat for at-risk species. Projects occurring in these areas should incorporate restoration prescriptions, to ensure persistence of this habitat type.
- FW-WSW-DC 6 Watersheds support multiple uses (e.g., timber, recreation, grazing) with no long-term decline in ecological conditions. Short-term impacts occur only when they serve to improve conditions over the life of the plan.

- FW-WSW-RMZ-WR-S 2 In wetland areas, management activities, permitted uses, and structural developments (e.g., livestock water gaps, pipelines, or other infrastructure) may only occur when necessary to move toward water, soils, and vegetation desired conditions or to protect life and property.
- FW-WSW-RMZ-FSR-G 1 Connectivity within FSR should be maintained and enhanced by protecting ecological functions, tree density and growth, and native understory, to reduce the risk of predation and nest parasitism, and to provide habitat for at-risk and other wildlife species.
- FW-GRZ-S 1 Livestock management shall be compatible with capacity and address ecological resources (e.g., forage, invasive plants, at-risk species, soils, riparian health, and water quality) that are departed from desired conditions, as determined by temporally and spatially appropriate data.
- FW-REC-G 1 Recreation activities should be compatible with and managed adaptively to minimize impacts to at-risk species and ecological desired conditions, including in riparian management zones (e.g., along streams, around seeps, springs, lakes, and wetlands).

Aquatic Associates

(Streams, waterbodies, seeps/springs, riparian): American dipper, black swift, bald eagle, and golden eagle

Aquatic habitat includes seeps/springs, perennial streams, waterbodies, wetlands, and other water features that are highly departed. Migratory birds and eagles associated with this type of habitat would benefit from plan objectives that move aquatic/riparian ecological conditions toward the desired state. The objectives, total amount of ecological condition moved toward desired conditions, and effects differ across action alternatives. The differing amounts of ecological condition improved are highlighted in the individual sections for each alternative.

Plan components that would benefit migratory birds and eagles that depend on aquatic ecosystems can be found under the Nonnative Invasive Species, Wildlife, Fish, and Plants, Watershed, and all Water Resources sections of the action alternatives. Additional plan components which balance multiple use with wildlife needs can be found under the Sustainable Grazing and Livestock Management, Special Use, Recreation, and Roads sections.

Desired conditions for the Watershed and Water, Riparian Management Zones, Streams, Waterbodies, Springs and Seeps resource sections (FW-WSW-DC 1-3; FW-WSW-RMZ-DC 1-8; FW-WSW-RMZ-STM-DC 1-10; FW-WSW-RMZ-WB-DC 1-5; FW-WSW-RMZ-SNS-DC 1-7) would move these systems toward proper functioning condition, while balancing multiple uses with ecological integrity. These components would also improve altered hydrology by minimizing water diversions and improving hydrologic function, while maintaining systems that are resilient to climate change and associated disturbances such as fire. Guideline FW-WSW-G 1 would ensure that best management practices are applied to every site-specific project that has the potential to affect the watershed conditions. Several standards and guidelines (FW-WSW-G 2; FW-WSW-RMZ-G 1-4; FW-WSW-RMZ-WR-S 1-3) would mitigate adverse effects from road construction or reconstruction, which can cause sedimentation, and would also rehabilitate in stream structures, which could improve hydrologic function. Standards for Sustainable Forestry and Forest Products (FW-FFP-S 1-2) would protect the ecological integrity of watershed conditions by minimizing potentially adverse effects that could cause soil erosion and sedimentation during timber harvest operations. Plan components for the Sustainable Rangelands and Livestock Grazing resource (FW-GRZ-DC 4-6; FW-GRZ-S 1; FW-GRZ-G 1-2; FW-GRZ-G 5; FW-WSW-RMZ-STM-DC 11, FW-WSW-RMZ-WB-DC 6) would ensure associated management activities are compatible with ecological function and supportive of diverse native plant communities in wetland and riparian areas/riparian management zones that are adjacent to aquatic systems.

Desired Condition FW-WSW-RMZ-STM-DC 4 would promote riparian areas from streambed and flood plain alteration while guidelines for the roads (FW-WSW-G 2; FW-WSW-RMZ-G 3; FW-TFA-G 1-4; FW-TFA-G 6) would minimize disturbance (e.g., water flow, sedimentation) from the construction of roads by including mitigations to limit disturbance in riparian zones during project-level design.

Nonnative plant species can outcompete native species, causing reduction in suitable habitat and alterations in riparian function that may affect water quality, while nonnative invasive animals and pathogens can cause direct mortality and predation to aquatic species. These threats are reduced through plan components in the Nonnative Invasive Species and Wildland Fire Management resource sections of the plan through desired conditions, standards and guidelines (FW-NIS-DC 1; FW-NIS-S 1-2; FW-NIS-G 1, 3, 5-6; FW-FIRE-G 2-3) that minimize impacts to wildlife in riparian areas, aquatic habitat, and would also prevent pathogen transmission.

The following plan components, in addition to the ones stated above, would ensure protective measure are included for migratory birds and eagles that utilize aquatic ecosystems during project design:

- FW-WSW-DC 4 Aquatic habitats are connected and free from alterations (e.g., temperature regime changes, lack of adequate streamflow, constructed barriers to aquatic organism passage) to allow for species migration, connectivity of fragmented populations and genetic exchange. A constructed barrier to movement exists only to protect native aquatic species from nonnative aquatic species or for agricultural benefit (e.g., headgates).
- FW-WSW-DC 5 Aquatic and riparian habitats support self-sustaining populations of native fish, as well as other aquatic and riparian species, and provide the quantity and quality of aquatic and riparian habitat within reference conditions.
- FW-WSW-DC 6 Watersheds support multiple uses (e.g., timber, recreation, grazing) with no long-term decline in ecological conditions. Short-term impacts occur only when they serve to improve conditions over the life of the plan.
- FW-WSW-RMZ-DC 3 Native obligate wetland species dominate herbaceous bank cover.
- FW-WSW-RMZ-DC 4 Riparian vegetation (density and structure) provides site-appropriate shade to regulate water temperature in streams.
- FW-WSW-RMZ-DC 5 Riparian ecosystems exhibit connectivity between and within aquatic, riparian, and upland components that reflect their natural linkages and range of variability. Stream courses and other links provide habitat and movement that maintain and disperse populations of riparian-dependent species, including beaver. Riparian areas are connected vertically between surface and subsurface flows.
- FW-WSW-RMZ-STM-DC 2 Stream ecosystems, including ephemeral watercourses, are not fragmented by infrastructure or development, except when the fragmentation serves to protect native aquatic species from nonnative aquatic species. Streams provide connectivity important for dispersal, access to new habitats, perpetuation of genetic diversity, as well as nesting and foraging for at-risk species.
- FW-WSW-RMZ-STM-DC 3 Aquatic species are able to move throughout their historic habitat including opportunities for seasonal and opportunistic movements. Barriers to movement only exist to protect native aquatic species from nonnative aquatic species or for agricultural benefit (e.g., headgates).
- FW-WFP-DC 10 All aquatic and riparian habitats are hydrologically functioning and have sufficient emergent vegetation as described in Watersheds and Water desired conditions or site potential, as well as macroinvertebrate populations to support resident and migratory species.

- FW-GRZ- DC 4 Livestock grazing and associated management activities are compatible with ecological function and process (e.g., water infiltration, wildlife habitat, soil stability, and natural fire regimes).
- FW-FIRE-DC 8 Post-fire restoration and recovery should be provided where critical resource concerns merit rehabilitation for controlling the spread of invasive species, protecting areas of cultural concern, protecting critical or endangered species habitat, or protecting other highly valued resources.
- FW-WSW-RMZ-STM-S1, WB-S 1, SNS-S1 Management activities in and around streams shall use decontamination procedures to prevent the spread of non-desirable fungus, disease, nonnative and invasive biota.
- FW-FPP- S 2 Timber harvest shall only occur where soil, slope, and watersheds will not be irreversibly damaged, and protection must be provided for streams, streambanks, shorelines, lakes, wetlands, other waterbodies, fish, wildlife, recreation (including trails), and aesthetic resources.
- FW-WSW-RMZ-STM-G 3 Streambed should contain less than 20 percent fines (sand, silt, clay) in riffle habitat, to maintain fish spawning.
- FW-FAC-G 2 Facilities and structures should be designed and maintained to minimize impacts to terrestrial and aquatic species (e.g., bear-proof dumpsters, capped pipe used for fences, survey markers, and signpost, or wildlife egress in plumbing vents).
- FW-WFP-G 6 To conserve wildlife and fish habitat connectivity, constructed features (e.g., exclosures, wildlife drinkers, range improvements, fences, and culverts) should be maintained to support the purpose(s) for which they were built. Constructed features should be removed when no longer needed, to restore natural hydrologic function and maintain habitat connectivity.

Cliff, Caves, Mines, Rocky Features Associates

American peregrine falcon, American dipper, black rosy-finch, black swift, brown-capped rosy-finch, golden eagle, and prairie falcon

Ecological condition for migratory birds and eagles that utilize caves, mines, rocky features and cliff is largely realized through the Caves and Abandoned Mines, Cliffs and Rocky Features, Minerals and Mining, and Recreation sections. Desired conditions and guidelines ensure mining activities will be compatible with ecosystem health and wildlife ecological condition needs (FW-MM-DC 1-2; FW-WFP-G 7; FW-CRF-G1).

Desired conditions for cliffs and rocky features (FW-VEG-DC 17-19; FW-VEG-PPF-DC 19; FW-VEG-PJO-DC 14; FW-VEG-PJS-DC 16; FW-SL-DC 7; FW-CRF-DC 1-3; DA-BOT-DC 1-2) would promote ecological conditions for migratory bird and eagles that use these habitat features.

The following plan components and management approaches, in addition to the ones stated above, would ensure protective measure are included for migratory birds and eagles that use aquatic ecosystems during project design:

- FW-VEG-G 3 Vegetation should provide for at-risk species' habitats, by minimizing disturbance, providing recovery strategies, and managing for desired levels of key structural elements (e.g., large old trees and snags, downed woody debris, denser vegetation structure, and soil structure) important for nesting, rearing, breeding, foraging, dispersal, and other life history needs to maintain the persistence or contribute to the recovery of at-risk species.
- FW-VEG-ALP-G 1 Trail construction and maintenance in ALP should avoid minimize disturbance to at-risk plants and to important key habitat features (e.g., rock outcrops, willows, and talus slopes) for

at-risk species and other alpine dependent species (e.g., yellow-bellied marmot and American pika), to maintain the persistence of native species.

- FW-CRF-G 2 Rock climbing and related recreation activities should not disrupt the life processes of cliff or rocky feature dependent at-risk species (e.g., American peregrine falcon, spotted bat, and small-headed goldenweed), diminish the function of specialized vegetation (e.g., mosses, lichens, and small headed goldenweed), to maintain the persistence or contribute to the recovery of at-risk species.
- FW-WFP-G 3 Management activities should avoid disturbance at known active raptor nests and fledging areas, to maintain the persistence or contribute to the recovery of at-risk species. Timing restrictions, adaptive percent utilizations, distance buffers, or other means of avoiding disturbance should be based on the best available scientific information, as well as on site-specific factors (e.g., topography and available habitat).
- FW-REC-G 1 Recreation activities should be compatible with and managed adaptively to minimize impacts to at-risk species and ecological desired conditions, including in riparian management zones (e.g., along streams, around seeps, springs, lakes, and wetlands).

Management Approaches

1. Consider additional survey efforts, targeted monitoring, and research on life history and habitat needs, to fill information gaps on the rare and narrow endemic species that use cliffs and rocky features.
2. Consider working with public affairs, recreation, invasive species, and minerals staffs; State and other Federal agency partners; and the public to internally and externally increase the awareness and valuation of these features, especially for threatened, endangered, and species of conservation concern (e.g., small-headed goldenweed and peregrine falcon).
3. Consider partnering with volunteers, rock climbing organizations, other government agencies, cooperators, and permit holders to help co-manage sustainable rock climbing opportunities, including planning, design, implementation, operations, and maintenance of rock climbing areas.

Environmental Consequences for Migratory Birds and Golden and Bald Eagles – Alternatives 2 and 5

Alternatives 2 and 5 retain relevant plan direction from alternative 1 but are more responsive to current science and thinking, while addressing the core themes and significant issues explored during the plan revision process. The only difference between alternatives 2 and 5 is the amount of recommended wilderness, which was discussed in the effects common to all action alternatives. The primary difference between alternatives 2 and 5 and the other alternatives is the addition of three place based management areas with their own plan components, variation among management objectives and restoration, and objectives for road management. All other plan components would remain the same as those listed under All Action Alternatives. In addition to the environmental consequences for all alternatives described earlier, alternatives 2 and 5 would primarily differ from alternative 1 in the rate and magnitude of ecological condition restored for riparian dependent migratory bird and eagles, and migratory bird and eagles affected by frequent-fire adapted ecosystem treatment.

Frequent fire forest vegetation community is moderately- to highly-departed and trending away from reference conditions (see affected environment above and vegetation section of this document). Alternatives 2 and 5 would increase the current rate of mechanical treatment (27,500 to 60,000 acres during each 10-year period) and the current rate of wildland fire (100,000 to 165,000 acres during each 10-year period).

After 15 years, desired conditions for mixed conifer would remain moderately departed but would move closer to the desired state, changing from departure of 64 percent to 43 percent. ponderosa pine forest

would remain highly departed, but would move closer to the desired state, changing from 92 percent to 59 percent. This would be an improvement in ecological condition over alternative 1 for migratory birds and eagles that depend on frequent fire adapted ecosystems.

Watershed resources, riparian, and aquatic habitats are highly departed and are trending away from reference conditions as well. Alternatives 2 and 5 set objectives to restore structure and function of at least 200 to 300 acres of riparian areas annually, and objectives to restore, enhance, or maintain 100 to 150 stream miles, and 10 to 20 springs during each 10-year period. This also includes objectives (FW-TFA-O 1-3) and guidelines (FW-TFA-G 2 and 7) to maintain or decommission roads to improve watershed health. These plan components would move riparian and aquatic ecological condition across the forest closer to a desired state and would increase habitat availability for migratory birds and eagles.

Under alternatives 2 and 5, increased levels of mechanical and restoration treatments from objectives would cause increased temporary ground disturbance to frequent fire forest and riparian dependent migratory birds and eagles. However, within these alternatives, plan components specifically addressing soil and ground disturbance are found throughout all sections of the plan (FW-VEG-G 2, FW-SOIL-G-1 and 2, FW-WSW-DC 2, FW-GRZ-G 4-5, FW-TFA-G 1-2, FW-TFA-G 9-10, FW-REC-G 1, FW-FFP-S 2, FW-FFP-G-3, and FW-SU-G-1-3). There are also plan components and objectives (FW-TFA-O 1, FW-TFA-G 3 and 4, and FW-REC-O 6) within this alternative that seek to rehabilitate areas that are disturbed.

The primary plan components in management areas that could impact migratory birds and eagles and that differ from alternatives 3 and 4, include desired conditions and guidelines for the Grassland Maintenance Management Area (all ranger districts), Valle Vidal Management Area (Questa Ranger District), and San Antonio Management Area (Tres Piedras Ranger District). Grassland Maintenance (MA-GMMA-DC 1) preserves woodlands and ponderosa pine forest in a treeless state to promote forage production. Areas within this management area have been preserved in a treeless state for over 50 years and have not been available for woodland-dependent migratory birds use during this time. Under alternatives 2 and 5, there are 396,522 acres of woodland ecological condition that would be improved and continued to be used by migratory birds within woodland vegetation. This management area would increase grassland ecological condition for grassland dependent migratory birds and eagles such as burrowing owl, chestnut-collared longspur, golden eagle, mountain plover, prairie falcon, and rufous hummingbird. The following Grassland Maintenance Management Area plan components would maintain habitat used by migratory bird and eagles.

- MA-GMMA-DC 2 Regeneration, seed head production, and a balance of grass and forb species, including warm and cool season species, occur in most years and within the capability of soils.
- MA-GMMA-DC 3 Soil function is sustained. Soils are permeable and capable of infiltrating water to reduce overland flows during precipitation events and allow for burrowing by small mammals (Gunnison's prairie dog and masked shrew). Adequate water infiltration discourages arroyos, gullies, and head cuts from forming in drainages. Existing arroyos and gullies are stabilizing and recovering.
- Valle Vidal management area (MA-VVMA-DC 1, 2, 4, and 5) and San Antonio management area (MA-SAMA-DC 1, 3-4) are managed for multiple uses, focusing on the restoration and protection of diverse, resilient, biological communities for future generations, while providing a quality backcountry outdoor recreation experience. Valle Vidal and San Antonio MAs limits development and road construction. Existing closed and non-system roads would continue to naturalize and would diminish watershed and ecological condition impacts from sedimentation and habitat segmentation. Ecological condition improvement from limiting development and road construction would improve habitat utilized by migratory bird and eagles within these MAs.

Environmental Consequences for Migratory Birds and Golden and Bald Eagles – Alternative 3

The primary difference between alternative 3 and the other alternatives is the addition of two place-based management areas (Grassland Maintenance Management Area and Off-Highway Vehicle Management Area) with their own unique plan components, and the expansion of the Developed Winter And Summer Resort Management Area boundary. The San Antonio and Valle Vidal Management Areas found in alternatives 2, 4, and 5 are not included in this alternative. Alternative 3 uses mechanical treatment, wildfire, and fuelwood collection to decrease risk from stand-replacing wildfire and to improve ecosystem function. All other plan components would remain the same as those listed under all action alternatives.

Alternative 3 has higher restoration objective acres than any other alternative for fire-adapted ecosystems, and sustainability of springs, wetlands and riparian areas (improved watershed health). An increased emphasis on restoration intensity emphasizes partnerships to get more work done on the ground to achieve desired conditions at greater rate than the other alternatives. This should benefit migratory birds and eagles that depend on fire-adapted and riparian ecosystems by improving ecological condition at a faster rate and intensity in areas that need it most.

Using mechanical treatments with frequent fire forest, there would be an increase to 65,000 to 130,000 acres treated during each 10-year period. Acres treated using prescribed fire would remain the same as alternatives 2 and 5 (100,000 to 165,000 acres during each 10-year period). Under alternative 3, in 15 years, desired conditions for mixed conifer would remain moderately departed but would move closer to the desired state, changing from of departure of 64 percent to 33 percent. Ponderosa pine would become moderately departed (41 percent), an improvement from current conditions (92 percent departure). For migratory birds and eagles that depend on fire-adapted ecosystems, this alternative would realize the greatest overall improvement in ecological condition. However, widespread mechanical treatment under alternative 3 would result in the most ground disturbance and associated effects to understory vegetation. Localized, short-term impacts to soil stability and erodibility, with subsequent watershed impacts such as increased sedimentation, would be more likely. There may be higher probability of localized invasive species distribution and establishment in disturbed areas. Increased sedimentation, increased ground disturbance, and increases in invasive species distribution would negatively impact habitat utilized by migratory bird and eagles.

This alternative places more emphasis on human uses, therefore road maintenance is emphasized with the potential to increase road use. Temporary roads would be considered for inclusion into the system to support multiple use activities and access to the forest as an alternative to decommissioning. In addition, this alternative proposes the Off-Highway Vehicle Management Area on the Camino Real Ranger District. The Off-Highway Vehicle Management Area would allow cross-country travel opportunities within the management area to provide challenging terrain for trials motorcycles and off-highway vehicle rock crawling. The added footprints of increased road activity and the proposed off-highway vehicle management area would increase ground and soil disturbance and would increase intrusive human activity (vehicle noise) impacts within this management area on migratory bird and eagles.

The Grassland Maintenance Management Area (forestwide) is also proposed under this alternative, and effects from plan components for Grassland Maintenance Management Area would be the same as described for alternatives 2 and 5.

The Developed Winter and Summer Resort Management Area comprises the permitted ski areas on the Carson. This management area is currently managed in an altered vegetative state from reference condition and would continue to be managed as such under alternative 3. However, under this alternative the developed winter and summer resort management area would be expanded by 921 acres around the Sipapu Ski and Summer Resort. The current Sipapu permitted boundary is 215 acres and would not

change under any alternatives except alternative 3 where it would likely be expanded through a separate analysis. Expansion of this boundary would alter current vegetation from a forested to a grassland state, thereby possibly decreasing frequent fire forest ecological conditions, decreasing habitat connectivity, and would possibly increase ground disturbance and human intrusive disturbance from ski area development within the expanded part of this management area for migratory birds that utilize this area. However, the expansion of this management area would increase habitat for migratory bird that utilize grassland habitat. Effects from the current permitted boundary for this management area are analyzed under environmental consequences common to all alternatives.

This alternative, with increased mechanical treatment, would move departed ecological conditions of frequent fire forest toward desired condition the fastest. However, the increased mechanical treatment, potential to increase road use, the inclusion of off-highway vehicle management area, and the expansion of developed winter and summer resort management area would also have the greatest increase in ground disturbance and human intrusive disturbance. Watershed conditions would be worse compared to alternative 2, with cascading impacts on riparian function.

Environmental Consequences for Migratory Birds and Golden and Bald Eagles – Alternative 4

The primary difference between alternative 4 and the other alternatives is the greater use of naturally ignited wildfires and prescribed fires to achieve restoration objectives (125,000 to 225,000 acres during each 10-year period) under alternative 4. Mechanical treatment would focus on treating fuels to protect communities instead of forestwide restoration. Alternative 4 also includes four placed based management areas which would have their own plan components. Otherwise, forestwide plan components would be the same as described previously under environmental consequences for all action alternatives. Under alternative 4, unplanned ignitions would be encouraged to play their natural role in ecosystems at the landscape level more than other alternatives. Current understanding of fire and its use has evolved over the last 50 years and the scientific community now recognizes the beneficial effects lower-intensity wildfire may have on forest structure and wildlife ecological condition (Millar and Stephenson 2015; C. Miller and Aplet 2016). A caveat to this would be high-intensity, landscape-scale fires that would be detrimental to habitat utilized by frequent fire-adapted migratory bird and eagles.

After 15 years, desired conditions for mixed conifer with frequent fire would remain moderately departed but would move closer to the desired state, changing from a departure of 64 percent to 44 percent. Ponderosa pine forest would remain highly departed (71 percent), a moderate improvement from current conditions (92 percent departure). For migratory birds and eagles that depend on frequent fire adapted ecosystems, this alternative would be similar to alternative 2 in terms of overall ecological condition improved for these two vegetation types. However, the decrease of mechanical treatment could also put these species at greater risk for reductions of foraging, nesting, and roosting habitat resulting from uncharacteristic, stand-replacing wildfire.

Proposed management areas included under alternative 4 are Wetland Jewels Management Area (forestwide), Valle Vidal Management Area (Questa Ranger District), San Antonio Management Area (Tres Piedras Ranger District), and Rio Grande Cutthroat Trout Management Area (forestwide). Effects from these management areas to migratory birds and eagles are described in more detail below.

Alternative 4 limits motorized access through several means, including stricter guidance regarding the creation of new permanent or temporary roads (FW-TFA-S 3-4), obliterating or naturalizing double the number of miles of non-system roads (FW-TFA-O 1), expanding the San Antonio Management Area and requiring seasonal closures (MA-SAMA-S 8-9), prohibiting new motorized trails within Valle Vidal and San Antonio Management Areas (MA-VVMA-S- 24, MA-SAMA-S-12), and prohibiting new permanent roads or motorized trails in the Wetland Jewels Management Area (MA-WJMA-S-1). Direct riparian impacts such as sedimentation and vegetation removal would be slightly reduced overall. Invasive species

spread would be slowed somewhat related to reduced access by motorized vectors, but treatment to restore riparian function may also be made more difficult in some locations. Decreases in ground disturbance, intrusive human activity, sedimentation, and distribution of invasive species would beneficially impact migratory bird and eagles.

Valle Vidal and San Antonio Management Areas would have similar effects as discussed for alternatives 2 and 5, with the exception of the above discussion on limiting motorized access. Grassland Maintenance Management Area is not proposed under this alternative; therefore, these areas would revert to woodlands or Ponderosa Pine Forest under this alternative. Woodland- and ponderosa pine-dependent migratory bird and eagles would have more acres available under this alternative, but grassland ecological conditions would decrease for grassland-dependent migratory birds and eagles.

Wetland Jewels Management Area would focus road obliteration and riparian restoration work in these areas rather than in priority watersheds, which is where riparian restoration activities are focused in all other action alternatives. The efficacy or feasibility of treating these areas is not clearly greater than they are for treating other locations on the forest. In fact, treatment return on investment is likely to be low, since 49 percent of the Wetland Jewels Management Area is in either Designated Wilderness, Recommended Wilderness, or Inventoried Roadless Areas, each of which restricts management options compared to other forest areas. For example, earth work or moving boulders by hand is costlier, time consuming, and labor intensive than doing the same work with machinery (refer to riparian vegetation section). Wetland Jewels Management Area should benefit migratory birds and eagles that may utilize this management area, but emphasis on aquatic and riparian restoration within this management area would improve forestwide ecological conditions for riparian and aquatic vegetation communities at a slower rate and intensity than other action alternatives.

Rio Grande Cutthroat Trout Management Area would focus native aquatic species restoration work in these areas and would not have an impact on aquatic habitat used by migratory birds and eagles.

This alternative would also have the highest negative impact from uncharacteristic stand-replacing wildfire.

Summary of All Alternatives for Migratory Birds and Golden and Bald Eagles

Under all alternatives, there would be no measurable negative effects at the population level of migratory bird species or bald and golden eagles. The Carson would continue to work with partners to implement restoration projects and inventory, monitoring and assessment work to help conserve migratory birds and eagles.

The amount of high elevation forest, non-forested, woodlands vegetation systems and abiotic features (including caves/mines, rocky outcrops, cliffs, canyon habitat, and soils) are not expected to change under any alternative. These vegetation types are expected to remain either low to moderately departed (at risk) in the near and distant future ([Vegetation Communities and Fuels](#)). These same conditions and trends also apply to vegetation-related characteristics such as fire regime, patch size, species composition, ground cover, soil condition, etc., as these characteristics are intricately associated with, and dependent on, vegetation structure. Active management activities could affect habitat utilized by migratory bird species but would not have a measurable negative effect at the population level of migratory bird species.

For all alternatives, future management is concentrated in the frequent fire forest, riparian, and aquatic systems, which are the most highly departed from reference conditions. Management intensity in these systems varies by alternative, but overall, all alternatives move the Carson toward the desired state (table 5), and would benefit habitat for migratory bird species and eagles.

Habitat Connectivity

The Carson NF is a highly important landscape for wildlife habitat connectivity (Wan et al. 2018). Habitat connectivity for wildlife is the premise that terrestrial and aquatic animals are able to move freely about their environment in order to access necessary resources or seek other individuals within their species for the purpose of fulfilling basic life-cycle needs. Connectivity may be negatively impacted by two primary issues: impaired ecological conditions and physical obstructions.

Ecological conditions, or condition of the habitat, may be an equally, if not more, important aspect of habitat connectivity for wildlife, but is often disregarded because it is not as obvious as highly visible obstructions. The reason this may be more important to habitat connectivity for wildlife is because it affects all wildlife, not just large terrestrial animals. Animals have evolved in their habitats, usually under reference vegetative conditions, including specific habitat features. Reference ecological conditions are critical for connectivity to be maintained for all wildlife. Optimum habitat conditions address the issue of scale and accommodates species that still require free movement, but not necessarily at the macro-scale where large-constructed features become an obstruction. These conditions may have influenced the development of long- and short-range migration routes. For example, amphibians travelling from one ephemeral pond to another may only travel a short distance but may need specific conditions within the span of one pond to the other. Soil moisture or bare patches may be key components that influence movement. Without optimal conditions (reference conditions), movement may be hindered, and connectivity broken. Therefore, altered or out-of-reference conditions may impact a species' ability to move and may be a larger concern for a majority of species within the forest. It is assumed reference habitat conditions will provide optimum habitat connectivity for all wildlife species.

Physical obstructions tend to be more species-specific and usually impact large terrestrial animals that travel great distances to secure resources or aquatic animals that are restricted to very linear waterways. Significant movements of these animals, outside of normal daily movements, usually occur seasonally but may take place within a very short period of time. Physical obstructions include, but are not limited to, developments (facilities and infrastructure), major roadways or high concentration of roads, impassable fencing, high-density energy development operations (e.g., oil wells, wind farms, etc.), dams or other aquatic barriers, utilities/rights-of-ways, or any other obstacle that impedes an animal's movements. The obstructions may block an animal's movements entirely or cause the animal to expend additional and much-needed energy to go around the obstruction. When animals are unable to move freely about their environment, habitat connectivity for wildlife is compromised and the animals may be negatively impacted, thus decreasing their persistence on the forest.

Environmental Consequences for Habitat Connectivity

Environmental Consequences for Habitat Connectivity Common to All Alternatives

All five alternatives would use mechanical vegetation treatment and wildfire to manage frequent fire forest (e.g., dry mixed conifer and ponderosa pine) and mechanical vegetation treatment or structural improvement to manage riparian/water resources (e.g., aquatics, forested riparian) as all of these systems are highly departed from reference conditions. Mechanical vegetation treatments or structural improvements within frequent fire forest and riparian and aquatic systems would improve ecological condition, abundance, and distribution, thereby improving habitat connectivity for wildlife that depend on those vegetation systems. Current science demonstrates the positive benefits that forest fuel-reduction treatments can have in terms of improving resiliency in frequent fire-adapted systems of the west/southwest (Stephens et al. 2012). For all alternatives, future management is concentrated in the frequent fire forest, riparian, and aquatic systems, which are the most highly departed from reference conditions. Management intensity, magnitude, and location of treatment in these systems varies by alternative, but overall all alternatives move the Carson toward the desired state (table 5).

Conditions and trends in high-elevation forest, non-forested, woodlands vegetation systems and abiotic features (including caves/mines, rocky outcrops, cliffs, canyon habitat, and soils) did not raise significant concerns, therefore no objectives were developed for them. The Carson has, however, identified desired conditions for these other vegetation communities and would implement management to make progress toward desired conditions as capacity allows. These vegetation types are expected to remain either low to moderately departed (at risk) in the near and distant future ([Vegetation Communities and Fuels](#)). These same conditions and trends also apply to vegetation-related characteristics such as fire regime, patch size, species composition, ground cover, soil condition, etc., as these characteristics are intricately associated with, and dependent on, vegetation structure. High-elevation forest, non-forested, woodlands vegetation systems and abiotic features are close to or at reference habitat conditions and therefore would provide habitat connectivity for all wildlife species under all alternatives.

Environmental Consequences for Habitat Connectivity – Alternative 1

The 1986 Forest Plan, as amended, lacks a description of desired conditions for many of the key ecological characteristics for wildlife, such as vegetation patch dynamics that influences animal movement and promotes connectivity of wide ranging species.

It does provide some protection against physical obstruction such as wildlife-friendly fences and aquatic species passage. The no-action alternative (alternative 1) also provides some direction on roads since there is guidance to “close or obliterate unnecessary roads” as they may impact wildlife habitat. However, road design does not address or mitigate the impact it has on connectivity. Lastly, there is no direction for developments (infrastructure or energy) or utilities to consider habitat connectivity for wildlife in their design or approval.

Since this alternative does not provide clear direction to address habitat connectivity for wildlife it is likely that some species, but not all, would continue to be negatively impacted by habitat connectivity for wildlife issues (physical obstructions and poor habitat conditions). Habitat connectivity for wildlife is not sufficiently addressed under this alternative.

Environmental Consequences for Habitat Connectivity Common to Action Alternatives 2, 3, 4, and 5

Specific forestwide plan components to address habitat connectivity for wildlife are integrated throughout multiple resource areas for all action alternatives. The cornerstones for addressing habitat connectivity for wildlife are the desired conditions within the Vegetation (FW-VEG-DC 5 and 9), Watershed and Water, and Wildlife, Fish and Plant (FW-WFP-DC 2, 5, 6, and 7) resource sections:

- **FW-VEG-DC 5 and FW-WFP-DC 2** Ecological conditions affecting habitat quality, distribution, and abundance contribute to self-sustaining populations of native and desirable nonnative plants and animals that are healthy, well distributed, genetically diverse, and connected (on NFS lands and to adjacent public and privately conserved lands), enabling species to adapt to changing environmental and climatic conditions. Conditions provide for the life history, distribution, and natural population fluctuations of the species within the capability of the ecosystem. Vegetation conditions allow for gradual transitions between vegetation communities. Transition zones shift in time and space, due to ecological processes affecting site conditions (i.e., fire and climate).
- **FW-VEG-DC 10 and FW-WFP-DC 5** Vegetation connectivity and abundance provide for genetic exchange, daily and seasonal movements of animals, and predator-prey interactions across multiple spatial scales, consistent with existing landforms and topography. Habitat configuration and availability and species genetic diversity allow long distance range shifts of plant and wildlife populations, in response to changing environmental and climatic conditions.

- **FW-WSW-DC 4** Aquatic habitats are connected and free from alterations (e.g., temperature regime changes, lack of adequate streamflow, constructed barriers to aquatic organism passage) to allow for species migration, connectivity of fragmented populations and genetic exchange. A constructed barrier to movement exists only to protect native aquatic species from nonnative aquatic species or for agricultural benefit (e.g., headgates).
- **FW-WFP-DC 6** Habitat configuration and availability and species genetic diversity allow long distance range shifts of plant and wildlife populations, in response to changing environmental and climatic conditions. Barriers to movement may exist to protect native species and prevent movement of nonnative species (e.g., a fish structure to protect Rio Grande cutthroat trout from nonnative invasion).
- **FW-WFP-DC 7** Species are free to extent possible from harassment and human disturbance at a scale that impacts vital functions (e.g., breeding, feeding, and rearing young) that could affect persistence of the species.

Numerous plan components are addressed in multiple resource areas to ensure considerations for habitat connectivity for wildlife are adopted.

Ecological Condition

Reference ecological conditions (habitat condition) are critical for connectivity to be maintained for all wildlife. All action alternatives provides specific desired conditions for each vegetation community, Watershed and Water (watersheds, streams, waterbodies, seeps and springs) and Riparian (see appendix H for all habitat connectivity plan components) that provide for the ecological conditions necessary to maintain habitat connectivity for wildlife. Substantive differences among action alternatives include six place-based management areas, each having their own set of plan components. Other substantive differences between action alternatives that could impact habitat connectivity for wildlife include the amount of recommended wilderness being proposed, the role of mechanical treatments and wildland fire as restoration tools, the amount of riparian and aquatic systems restored, and the amount of roads maintained or decommissioned for ecosystem health. Objectives help increase the rate in which out-of-reference vegetation communities move toward reference conditions.

Physical Obstruction

Physical obstructions may develop from management actions from multiple resources. All action alternatives provide specific plan components that address physical obstruction in terms of habitat connectivity for wildlife throughout multiple resources. For example, a standard in the Range section states, “New or reconstructed fencing must allow for wildlife passage, except where specifically intended to exclude wildlife (such as elk enclosure fence) or to protect human health and safety.” Another guideline in the Transportation and Forest Access section states, “To improve habitat connectivity, methods that accommodate wildlife (e.g., fencing, underpasses, overpasses, larger culverts) should be used when constructing or reconstructing highways or high traffic volume Forest Service roads.” Plan components addressing habitat connectivity for wildlife are found within all sections of the plan for all action alternatives. The entire suite of plan components addressing this issue can be found in appendix H. Some specifics for addressing physical obstructions, but not all, are as follows (see appendix H):

- A desired condition in the Vegetation section states, “The transition from NFS lands to adjacent lands with similar desired conditions are being met is seamless and does not exhibit abrupt changes in visual or ecological integrity. Maintaining seamless boundaries both on and off the forest would help ensure wildlife can move freely when habitat is in proper reference condition.
- Fencing which may impact animal movements of large terrestrial animals on the forest is addressed by multiple plan components including an objective to remove fencing that is no longer necessary or

non-functional (FW-WFP-O 4). A Range standard (FW-GRZ-S-2) also provides guidance on fence construction to allow for wildlife passage.

- Utilities/Rights-of-way that may impact animal movements on the forest are addressed by multiple plan components including a guideline (FW-SU-G 4) that upgraded energy and utility lines should be located and designed to minimize impacts to wildlife, scenery, and wildfire risk. A subsequent guideline (FW-SU-G 6) states, “To prevent unnecessary environmental disturbance, existing utility rights-of-way should be used to their capacity, before evaluating new routes.”
- High-Density Energy Developments may impact animal movements on the forest. Besides plan component addressing habitat connectivity for wildlife through consideration within special use permits, the proposed action addresses connectivity in the mineral and energy sections as well. A desired condition (FW-MM-DC 1) within the Minerals section seeks to meet the legal mandates to facilitate the development of minerals in a manner that minimizes adverse impacts to surface and groundwater resources, watershed and forest ecosystem health, wildlife and wildlife habitat, scenic character, and other desired conditions applicable to the area.

All action alternatives provide clear direction to address habitat connectivity for wildlife in multiple resource areas. Therefore, it is likely that issues affecting habitat connectivity for wildlife (poor habitat conditions and physical obstructions) would be properly addressed under all action alternatives.

Environmental Consequences for Habitat Connectivity – Alternatives 2 and 5

Alternatives 2 and 5 retain relevant plan direction from alternative 1 but are more responsive to habitat connectivity for wildlife. The primary difference between alternatives 2 and 5 and the other alternatives is the addition of management areas with their own plan components, variation among management objectives and restoration, and objectives for road management. All other plan components would remain the same as those listed under All Action Alternatives. In addition to the environmental consequences for all alternatives described earlier, alternatives 2 and 5 would primarily differ from alternative 1 in the rate and magnitude of ecological condition restored for riparian, aquatic, and frequent-fire adapted ecosystem.

Frequent Fire Forest vegetation community is moderately to highly departed and trending away from reference conditions (see affected environment above and vegetation section of this document).

Alternatives 2 and 5 would increase the current rate of mechanical treatment (27,500 to 60,000 acres during each 10-year period) and the current rate of wildland fire (100,000 to 165,000 acres during each 10-year period).

After 15 years, desired conditions for mixed conifer would remain moderately departed but would move closer to the desired state, changing from departure of 64 percent to 43 percent. While ponderosa pine forest would remain highly departed, but would move closer to the desired state, changing from 92 percent to 59 percent. This would be an improvement in ecological condition and habitat connectivity for wildlife in Frequent Fire Forest over alternative 1.

Watershed resources, riparian, and aquatic habitats are highly departed and are trending away from reference conditions. Alternatives 2 and 5 set objectives to restore structure and function of at least 200 to 300 acres of riparian areas annually, and objectives to restore, enhance, or maintain 100 to 150 stream miles, and 10 to 20 springs during each 10-year period. This also includes objectives (FW-TFA-O 1-3) and guidelines (FW-TFA-G 2 and 7) to maintain or decommission roads to improve watershed health. These plan components would move riparian and aquatic ecological condition across the forest closer to a desired state and would improve habitat connectivity for wildlife.

Under alternatives 2 and 5, increased levels of mechanical and restoration treatments from objectives would cause increased temporary ground disturbance to Frequent Fire Forest and riparian vegetation system and would temporally decrease habitat connectivity for wildlife. However, within these

alternatives, plan components specifically addressing soil and ground disturbance are found throughout all sections of the plan (FW-VEG-G 2, FW-SOIL-G-1 and 2, FW-WSW-DC 2, FW-GRZ-G 4-5, FW-TFA-G 1-2, FW-TFA-G 9-10, FW-REC-G 1, FW-FFP-S 2, FW-FFP-G-3, and FW-SU-G-1-3). There are also plan components and objectives (FW-TFA-O 1, FW-TFA-G 3 and 4, and FW-REC-O 6) within this alternative that seek to rehabilitate areas that are disturbed. The entire suite of plan components addressing these obstructions can be found in appendix H.

Roads may interrupt movements of multiple terrestrial species, but if not designed properly may also have severe negative impacts on aquatic species. Therefore, alternatives 2 and 5 offer multiple plan components to address and reduce the effect of roads on habitat connectivity (FW-TFA-DC 5, FW-TFA-S 3, FW-TFA-G 1-4, and FW-TFA-G 6-8).

The primary plan components in management areas that could impact habitat connectivity for wildlife and that differ from alternatives 3 and 4 include desired conditions and guidelines for Valle Vidal Management Area (Questa Ranger District), and San Antonio Management Area (Tres Piedras Ranger District). Valle Vidal Management Area (MA-VVMA-DC 1, 2, 4, and 5) and San Antonio Management Area (MA-SAMA-DC 1, 3-4) are managed for multiple uses, focusing on the restoration and protection of diverse, resilient, biological communities for future generations, while providing a quality backcountry outdoor recreation experience. Valle Vidal and San Antonio Management Areas limit development and road construction, which would improve habitat connectivity for wildlife. Existing closed and non-system roads would continue to naturalize and would diminish watershed and ecological condition impacts from sedimentation and habitat segmentation. Ecological condition improvement from limiting development and road construction would improve habitat connectivity for wildlife.

Environmental Consequences for Habitat Connectivity – Alternative 3

The primary difference between alternative 3 and the other alternatives is the addition of management areas with their own unique plan components. The San Antonio and Valle Vidal Management Areas found in alternatives 2, 4, and 5 are not included in this alternative. Alternative 3 uses mechanical treatment, wildfire, and fuelwood collection to decrease risk from stand-replacing wildfire and to improve ecosystem function. All other plan components for habitat connectivity for wildlife would remain the same as those listed under All Action Alternatives.

Using mechanical treatments within frequent fire forest, there would be an increase to 65,000 to 130,000 acres treated during each 10-year period. Acres treated using prescribed fire would remain the same as alternatives 2 and 5 (100,000 to 165,000 acres during each 10-year period). Under alternative 3, in 15 years, desired conditions for mixed conifer would remain moderately departed but would move closer to the desired state, changing from of departure of 64 percent to 33 percent. Ponderosa pine would become moderately departed (41 percent) an improvement from current conditions (92 percent departure). This would be a greater improvement in ecological condition in Frequent Fire Forest over all other alternatives. However, widespread mechanical treatment under alternative 3 would result in the most ground disturbance and associated effects to understory vegetation. Localized, short-term impacts to soil stability and erodibility, with subsequent watershed impacts, such as increased sedimentation, would be more likely. There may be higher probability of localized invasive species distribution and establishment in disturbed areas. Increased sedimentation, increased ground disturbance, and increases in invasive species distribution would decrease habitat connectivity for wildlife.

This alternative places more emphasis on human uses, therefore, road maintenance is emphasized with the potential to increase road use. Temporary roads would be considered for inclusion into the system to support multiple use activities and access to the forest as an alternative to decommissioning. In addition, this alternative proposes an off-highway vehicle management area on the Camino Real Ranger District. The Off-Highway Vehicle Management Area would allow cross-country travel opportunities within the management area to provide challenging terrain for trials motorcycles and off-highway vehicle rock

crawling. The added footprints of increased road activity and the proposed Off-Highway Vehicle Management Area would increase ground and soil disturbance, increase intrusive human activities (vehicle noise), and increase habitat segmentation that would decrease habitat connectivity.

The Developed Winter and Summer Resort Management Area comprises the permitted ski areas on the Carson. This management area is currently managed in an altered vegetative state from reference condition and would continue to be managed as such under alternative 3. However, under this alternative, the Developed Winter and Summer Resort Management Area would be expanded by 921 acres around the Sipapu Ski and Summer Resort. The current Sipapu permitted boundary is 215 acres and would remain this acreage under all alternatives except alternative 3 where it would likely be expanded through a separate analysis. Expansion of this boundary would alter current vegetation from a forested to a grassland state, increase ground and soil disturbance, increase intrusive human activities, and increase habitat segmentation that would decrease habitat connectivity from ski area development within the expanded part of this management area for frequent fire forest species that use this area. However, the expansion of this management area would increase habitat connectivity for species that use grassland habitat. Effects from the current permitted boundary for this management area are analyzed under Environmental Consequences Common to All Alternatives.

This alternative, with increased mechanical treatment, would move departed ecological conditions of frequent fire forest toward desired condition the fastest. However, the increased mechanical treatment, potential to increase road use, and the inclusion of the Off-Highway Vehicle Management Area would also have the greatest increase in ground disturbance. Watershed conditions would be worse compared to alternative 2, with cascading impacts on riparian function, thereby decreasing habitat connectivity.

Environmental Consequences for Habitat Connectivity – Alternative 4

The primary difference between alternative 4 and the other alternatives is the greater use of naturally ignited wildfires and prescribed fires to achieve restoration objectives (125,000 to 225,000 acres during each 10-year period) under alternative 4. Mechanical treatment would focus on treating fuels to protect communities instead of forestwide restoration. Alternative 4 also includes management areas which would have their own plan components. Otherwise, forestwide plan components for habitat connectivity for wildlife would be the same as described previously under Environmental Consequences for All Action Alternatives. Under alternative 4, unplanned ignitions would be encouraged to play their natural role in ecosystems at the landscape level more than other alternatives. Current understanding of fire and its use has evolved over the last 50 years and the scientific community now recognizes the beneficial effects lower-intensity wildfire may have on forest structure and wildlife ecological condition (C. Miller and Aplet 2016). A caveat to this would be high-intensity, landscape-scale fires that would be detrimental to habitat connectivity for wildlife.

After 15 years, desired conditions for mixed conifer with frequent fire would remain moderately departed but would move closer to the desired state, changing from a departure of 64 percent to 44 percent. ponderosa pine forest would remain highly departed (71 percent), a moderate improvement from current conditions (92 percent departure). This alternative would be similar to alternative 2 in terms of overall ecological condition and habitat connectivity improved for these two vegetation types. However, the decrease of mechanical treatment could also have greater risk for reductions of habitat connectivity for wildlife resulting from uncharacteristic, stand-replacing wildfire.

Proposed management areas included under alternative 4 include: Wetland Jewels Management Area (forestwide), Valle Vidal Management Area (Questa Ranger District), San Antonio Management Area (Tres Piedras Ranger District), and Rio Grande Cutthroat Trout Management Area (Forestwide).

Alternative 4 limits motorized access through several means, including stricter guidance regarding the creation of new permanent or temporary roads (FW-TFA-S 3-4), obliterating or naturalizing double the

number of miles of non-system roads (FW-TFA-O 1), expanding the San Antonio management area and requiring seasonal closures (MA-SAMA-S 8-9), prohibiting new motorized trails within Valle Vidal and San Antonio Management Areas (MA-VVMA-S- 24, MA-SAMA-S-12), and prohibiting new permanent roads or motorized trails in the Wetland Jewels Management Area (MA-WJMA-S-1). This would have the greatest improvement to habitat connectivity for wildlife from physical obstruction impacts.

Valle Vidal and San Antonio MAs would have similar effects as discussed for alternatives 2 and 5, with the exception of the above discussion on limiting motorized access.

Wetland Jewels Management Area would focus road obliteration and riparian restoration work in these areas rather than in priority watersheds, which is where riparian restoration activities are focused in all other action alternatives. The efficacy or feasibility of treating these areas is not clearly greater than they are for treating other locations on the forest. In fact, treatment return on investment is likely to be low, since 49 percent of the Wetland Jewels Management Area is in either Designated Wilderness, Recommended Wilderness, or Inventoried Roadless Areas, each of which restricts management options compared to other forest areas. For example, earth work or moving boulders by hand is more costly, time consuming, and labor intensive than doing the same work with machinery. Wetland Jewels management area should benefit habitat connectivity for wildlife within this MA, but emphasis on aquatic and riparian restoration within this management area would improve forestwide ecological conditions and habitat connectivity for riparian and aquatic vegetation communities at a slower rate and intensity than other action alternatives.

Rio Grande Cutthroat Trout Management Area would focus native aquatic species restoration work in these areas, rather than forestwide or at the discretion of the New Mexico Department of Game and Fish. Treatments to remove nonnative species (MA-RGCTMA-O 1) and desired condition that improves connectivity and ecological condition within the Rio Grande cutthroat trout management area (MA-RGCTMA-DC 1) would increase native aquatic species distribution within this MA.

Summary of All Alternatives for Habitat Connectivity

Providing habitat connectivity for wildlife is critical for maintaining all wildlife species on the forest. Physical obstructions that may block migratory routes of large terrestrial mammals or aquatic organisms need to be properly designed or removed when no longer functioning as intended. Likewise, maintaining reference ecological conditions is critical for allowing all species, regardless of scale, the opportunity to move freely about the forest to meet all their life-cycle needs. Alternative 1 provides minimal guidance on maintaining habitat connectivity for wildlife and is unlikely to provide the benefits connectivity has for all forest species. Alternative 2 provides desired conditions, guidelines, and objectives that not only ensures habitat connectivity for wildlife, but also seeks to restore connectivity where physical obstructions or out-of-reference conditions exist. Alternative 4 provides the same benefits as alternative 2 but may restore connectivity at a higher rate due to its emphasis on natural processes and increased amounts of recommended wilderness. Alternative 3 offers the same plan components as alternative 2, however, due to the increased emphasis on human uses, it is likely that physical obstructions could increase, thus reducing habitat connectivity for wildlife. Alternatives 2 and 4 are the best options for increasing habitat connectivity for wildlife on the forest.

See appendix H for Plan components addressing habitat connectivity for wildlife.

Public Interest Species: Rocky Mountain Bighorn Sheep

Ovis canadensis canadensis are the largest wild sheep in North America. There are five known bighorn sheep herds (Latir, Wheeler Peak, Rio Grande Gorge, Red River, and Pecos) occurring on the Carson. Rocky Mountain bighorn sheep use a variety of habitats, but require rocky outcrops and cliffs for escape

from predators and for lambing (Beecham et al. 2007). Population numbers for Rocky Mountain bighorn sheep on the Carson is stable to increasing (figure 13).

The Latir, Wheeler Peak, and Pecos Wilderness herds inhabit the alpine tundra of the Latir, Wheeler Peak, Columbine/Hondo, and Pecos Wildernesses (figure 14 and figure 15). According to the Carson National Forest 2014 Assessment (USDA FS Carson NF 2015a), the ecological condition of the alpine and tundra ecological response unit in which these herds inhabit is lowly departed from reference condition on the Carson, and when intensified by climate change it is still only moderately departed into the future. In addition, all of the alpine and tundra these herds use already receives the highest level of protection, having been designated as wilderness. Designated wilderness areas provide high-quality and contiguous alpine tundra habitat and are less influenced by human and management activities. Designated wilderness areas are required to be managed according to the Wilderness Act.

The Red River herd inhabits cliff habitat along Highway 38 between Red River and Questa, while the Rio Grande Gorge herd inhabits the rocky outcrops and cliff of the Rio Grande Gorge (figure 16). Rocky outcrops and cliff ecological characteristics on the Carson are inherently stable for long periods of time because they are changed primarily by geologic forces.

The Latir herd carrying capacity for bighorn sheep is 76 (NMDGF 2005), and as of 2018 the population numbers for this herd was 70 (NMDGF 2018). The Wheeler Peak herd is divided into two subpopulations using habitat within the Wheeler Peak Wilderness and Columbine/ Hondo Wilderness. The Wheeler Peak herd carrying capacity for bighorn sheep is 243 (NMDGF 2005), and as of 2018 the population numbers for this herd was 275 (NMDGF 2018). The Pecos Wilderness herd carrying capacity for bighorn sheep is 330 (NMDGF 2005), and as of 2018 the population numbers for this herd was 400 (NMDGF 2018). Population goals or estimates of the projected carrying capacity for the Rio Grande Gorge and Red River herds have not been established at this time. The population numbers for the Red River herd currently is 90, while population number Rio Grande Gorge herd is currently 400 (NMDGF 2018). Rocky Mountain bighorn sheep are hunted within the State of New Mexico under a permit-drawing system with mandatory reporting that is regulated by the New Mexico Department of Game and Fish. There are four bighorn sheep hunting units on the Carson.

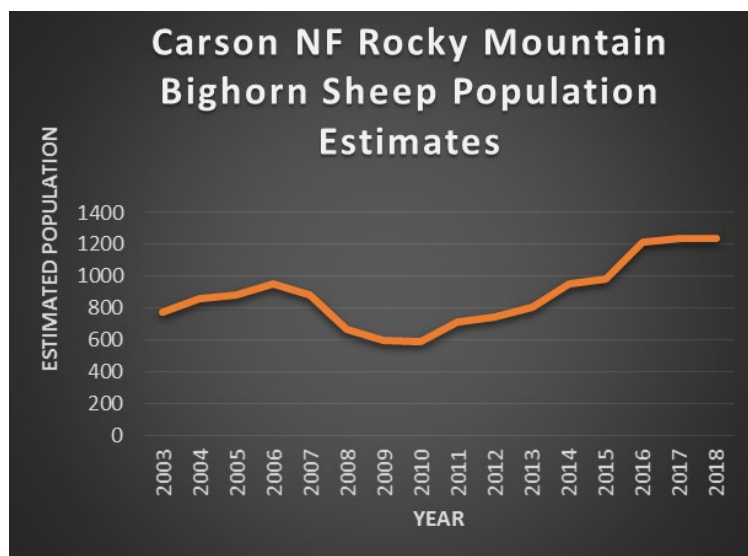


Figure 13. Estimated population from 2003-2018 of Rocky Mountain bighorn sheep on the Carson

Threats to Rocky Mountain bighorn sheep includes competition for forage and space with livestock and other ungulate species, human disturbance, and high susceptibility to epizootic pneumonia when in contact with domestic goats and sheep which are frequent carriers of disease (Besser et al. 2017; Besser et al. 2012). There are currently no areas of overlap between occupied bighorn sheep habitat and Carson permitted domestic sheep grazing allotments (figure 14 through figure 16). There are currently two domestic sheep allotments within 6 miles of the Rio Grande Gorge herd. These allotments have not been stocked recently with domestic sheep, and there are no known instances of bighorn sheep foraging onto these allotments at this time. The Rio Grande Gorge herd occupied habitat does overlap with private land and other Federal domestic sheep herds, but these are all outside of the Carson. The Rio Grande Gorge herd has not exhibited disease issues at this time.

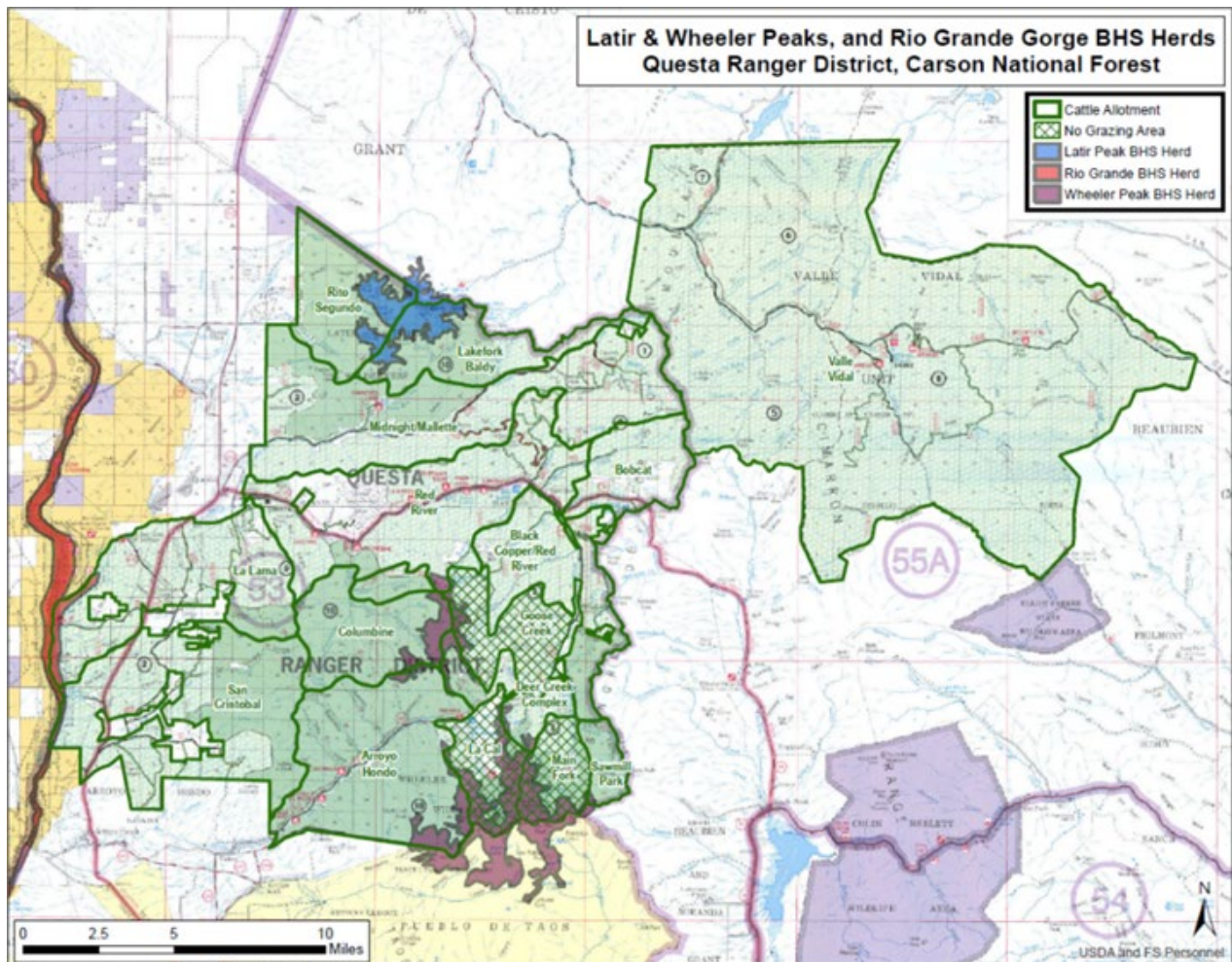


Figure 14. Latir, Wheeler Peak, Red River, Rio Grande Gorge bighorn sheep herds, and permitted livestock allotment on the Carson

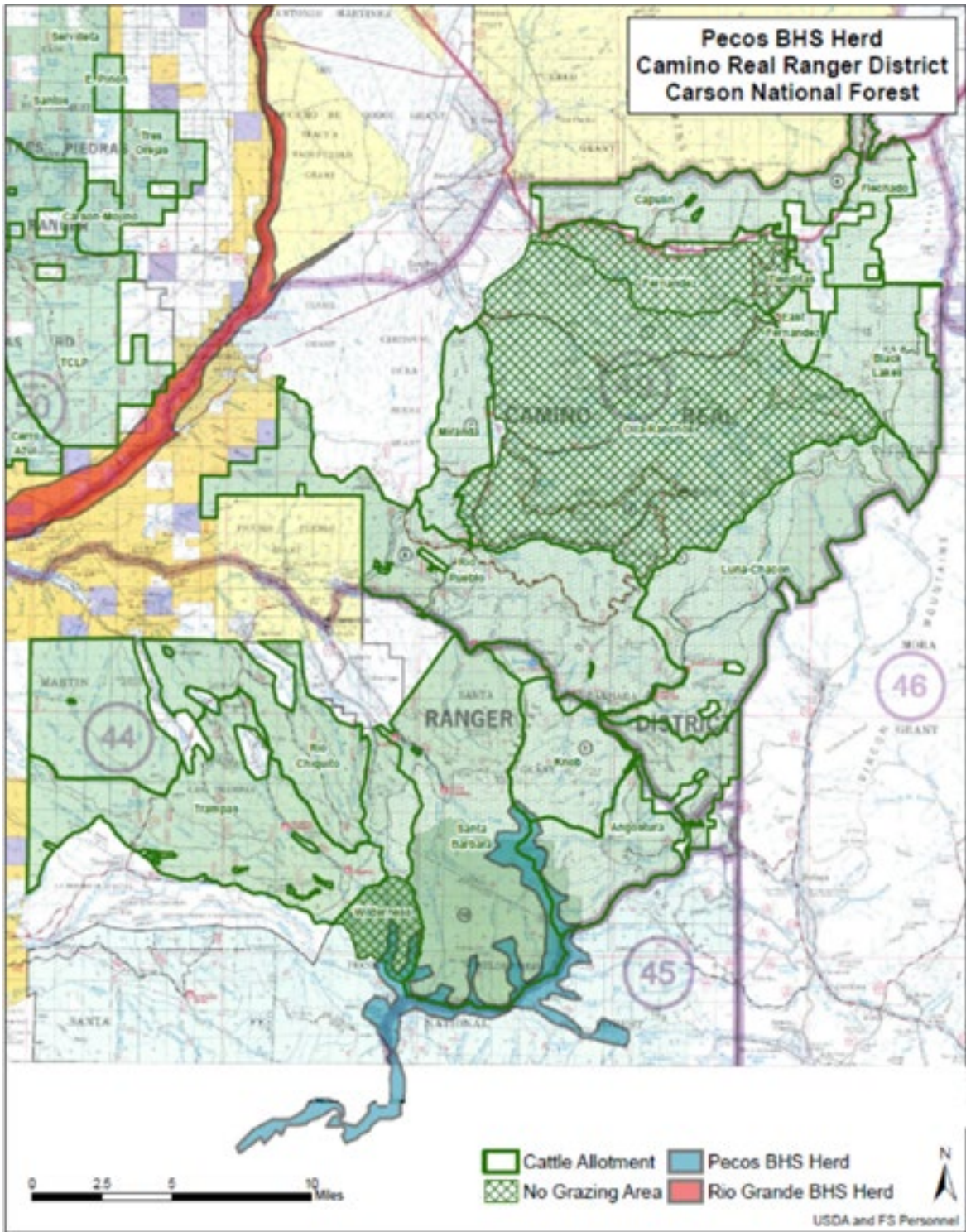


Figure 15. Pecos bighorn sheep herd and permitted livestock allotments on the Carson

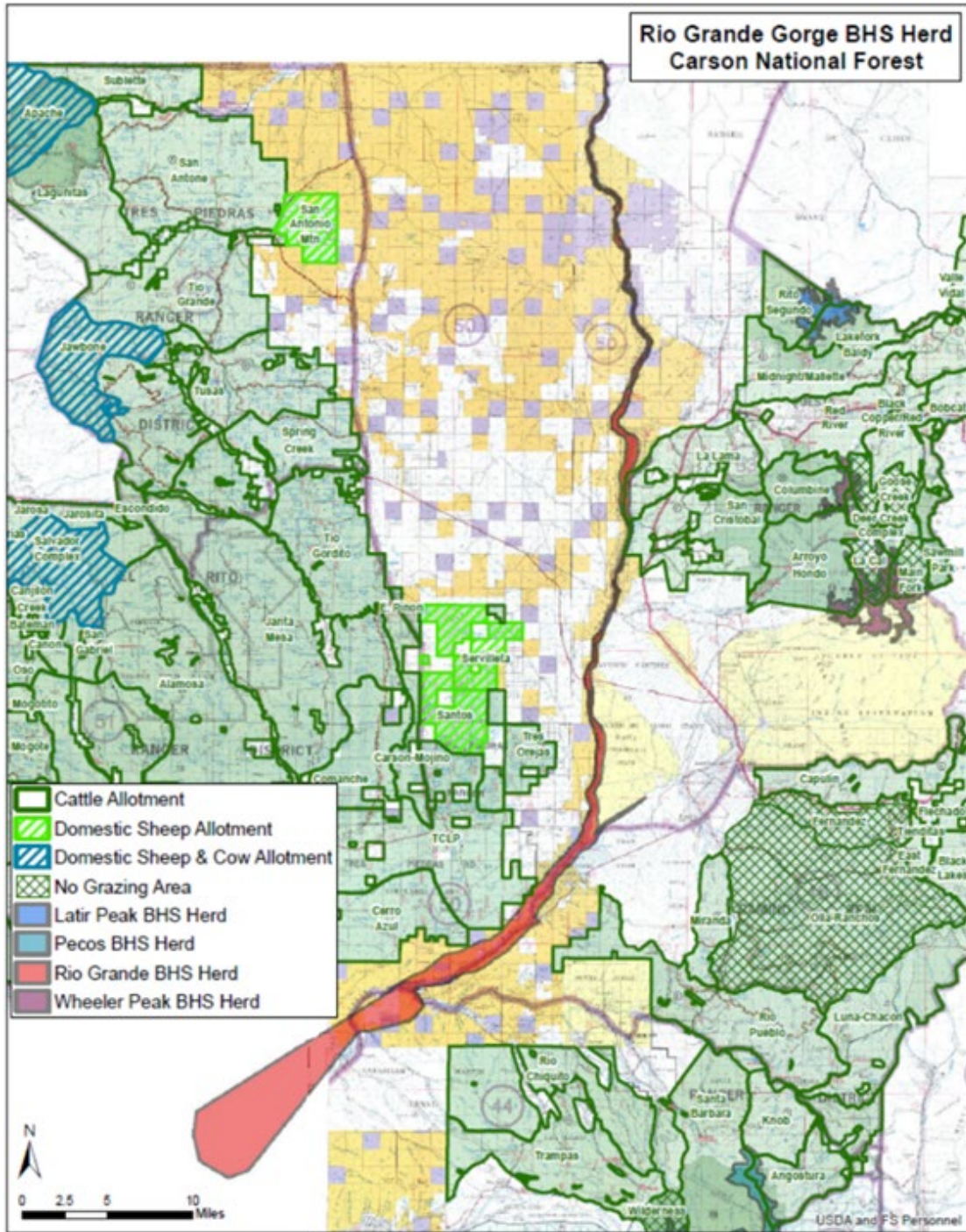


Figure 16. Rio Grande Gorge bighorn sheep herd and permitted livestock allotments on the Carson

Environmental Consequences for Bighorn Sheep

Ecological Condition

Under all alternatives, for all vegetation types, except frequent fire forests and riparian, future management would be similar to current management, and consequently, environmental consequences are expected to be similar under all plan alternatives. All vegetation types, except frequent fire forests and riparian, are expected to remain either low to moderately departed (at risk) in the near and distant future (vegetation communities and fuels). These same conditions and trends also apply to vegetation-related characteristics such as fire regime, patch size, species composition, ground cover, and soil condition, as these characteristics are intricately associated with, and are dependent on, vegetation structure. Abiotic features (including caves/mines, rocky outcrops, cliffs, canyon habitat, and soils) which are microsites within all vegetation are not expected to change under any alternative. Therefore, these ecological characteristics that bighorn sheep rely on would be maintain under all alternatives and would continue to provide ecological conditions needed for this species (see FEIS volume 3 appendix H section 5). Plan components would support key ecosystem characteristics for bighorn sheep because their cliff habitats would have low levels of disturbance. Most of the Carson's bighorn habitat is in steep, rugged, remote terrain and is within wilderness, where there is a relatively low level of human disturbance.

Disease

For bighorn sheep, where disease is a primary risk factor, it will be hard for the forest to mitigate risk beyond the forest boundaries. It will be difficult to prevent intermingling with diseased animals that may come and go from the forest, and effects discussed below of all alternatives for this species would be similar as they relate to managing for the outbreak or continuation of disease contact.

Climate Change

Climate change has occurred to some degree and will continue. Ramifications of a changing climate on wildlife are likely to include reduced snowfall or earlier snow melt in the spring, extended periods of drought or extended dry periods in the spring and summer, more frequent and larger wildfires, increased insect and disease-induced mortality, and changes in site characteristics that promote type conversion or vegetation community changes. This pattern is consistent with current trends in other parts of the west (Fettig et al. 2013).

These changes cause seasonal ranges and food sources for wildlife to shift and can affect the timing of reproduction. Reduced snowpack and changes in precipitation can affect wildlife by reducing water levels in lakes and ponds and can affect species that rely on deep or persistent snow. Forested tracts and remote habitats can also become isolated, reducing landscape connectivity and ecological condition for species with limited dispersal ability. The timing of spring green up can also affect food availability or forage conditions for big game. Those species with highly specialized ecological condition requirements, at the edge of their range, currently in decline, and/or having poor dispersal abilities may be particularly at risk (National Fish Wildlife and Plants Climate Adaptation Partnership 2012).

Climate change presents an aspect of uncertainty in future conditions, disturbance regimes, and vegetative and wildlife responses. Strategies that can be used to help reduce impacts from climate change include managing for diverse conditions, maintaining healthy and connected populations, reducing the risk of large uncharacteristic fire, preventing and controlling invasive species, and ensuring ecosystem processes and habitat connectivity (The Heinz Center 2008). While how well each of the alternatives addresses these strategies varies, it is assumed that to a certain extent, climate change and associated effects to wildlife would occur under all alternatives. The Climate Vulnerability Assessment for the Carson (USDA FS 2014a) provides additional information on the vulnerability of the different vegetation communities and habitat types to climate change.

Livestock grazing competition

From a forage perspective, bighorn sheep have the most dietary overlap with domestic sheep, cattle, and elk. Plan components under all alternatives for the sustainable rangelands and livestock grazing program areas (FW-GRZ-DC-4-6; FW-GRZ-S-1; FW-GRZ-G-2-3) emphasize that livestock grazing within riparian management zones must be compatible with ecological function and the needs of wildlife species, and that desired conditions for vegetation are sustained. These plan components would be beneficial by balancing multiple use with providing forage for bighorn sheep. Over the last decade, the Carson range staff has worked with partners and permit holders to manage grazing pressure on sensitive areas (such as critical areas and riparian areas).

Environmental Consequences for Bighorn Sheep – Alternative 1

The existing 1986 Forest Plan does not include specific plan direction to mitigate the potential for disease transmission to bighorn sheep from domestic sheep or goats. However, it does include language to “Support New Mexico Game and Fish Department in meeting its objectives of the New Mexico Comprehensive Wildlife Plan and in the reintroduction of native wildlife and fish species,” which could allow opportunities to mitigate the potential for disease transmission to bighorn sheep from domestic sheep or goats.

Environmental Consequences for Bighorn Sheep Common to Alternatives 2, 3, 4, and 5

All action alternatives add fine-filter plan components for the Rocky Mountain bighorn sheep to more clearly direct management emphasis on mitigating the potential for disease transmission to bighorn sheep from domestic sheep or goats. The main differences between the action alternatives in regard to mitigating the potential for disease transmission to bighorn sheep from domestic sheep or goats is the flexibility of strategies (FW-GRZ-S 4) used to mitigate the potential for disease transmission to bighorn sheep from domestic sheep or goats, and this will be discussed by alternatives.

Bighorn sheep plan components:

- **FW-NIS-S 3:** Domestic goats and sheep shall not be used to control invasive plants in native bighorn sheep occupied habitat⁹ or areas of high risk of contact.¹⁰
- **FW-WFP-DC 11:** Risk of disease transmission from permitted domestic sheep or goats to bighorn sheep is low.¹¹
- **FW-GRZ-S 4:**
 - ◆ For alternative 2, 3, and 5: Within bighorn sheep occupied habitat¹² or areas of high risk of contact¹³, domestic sheep allotments shall be managed (e.g., fencing, increased herding, herding dogs, potential vaccine, or other scientifically supported strategies) to mitigate the potential transfer of disease from domestic sheep to bighorn sheep.
 - ◆ For alternative 4: Domestic sheep allotments shall not be authorized within bighorn sheep occupied habitat to mitigate the potential transfer of disease from domestic sheep to bighorn sheep.

⁹ As defined by New Mexico Department of Game and Fish or best available science.

¹⁰ Based on risk of contact models or best available science.

¹¹ Based on risk of contact models or best available science.

¹² As defined by New Mexico Department of Game and Fish or best available science.

¹³ Based on risk of contact models or best available science.

- **FW-GRZ-G 8:** Permit conversions to domestic sheep or goats should not be allowed within bighorn sheep occupied habitat or areas of high risk of contact, to minimize the transfer of disease from domestic sheep to bighorn sheep.
- **FW-SU-S 3:** Use (e.g., outfitter/guide and filming) of domestic sheep or goats through special use permit authorization is prohibited in bighorn sheep occupied habitat or areas of high risk of contact.
- **DA-WILD-S 4:** Pack goats shall not be allowed within Wilderness.
- **DA-WSR-S 4:** Pack goats shall not be allowed within the Rio Grande Wild and Scenic River Corridor.

All action alternatives also include management approaches to provide further strategies on mitigating the potential for disease transmission to bighorn sheep from domestic sheep or goats:

- **Wildlife, Fish, Plants Management Approach 9:** Consider converting permitted domestic sheep allotments that are within Rocky Mountain bighorn sheep occupied habitat or areas of high risk of contact to permitted cattle allotments.
- **Sustainable Rangelands and Livestock Grazing Management Approach 8:** Facilitate a dialogue between the New Mexico Department of Game and Fish and permit holders about ungulates (e.g., elk, deer, bighorn sheep, and livestock) and the cumulative impacts on forest resources.

Environmental Consequences for Bighorn Sheep – Alternatives 2, 3, and 5

Alternatives 2, 3, and 5 incorporate plan components for mitigating the potential for disease transmission to bighorn sheep from domestic sheep or goats. The primary difference between alternatives 2, 3, and 5 and alternative 4 is the flexibility of strategies (FW-GRZ-S 4) used to mitigate the potential for disease transmission to bighorn sheep from domestic sheep or goats. All other plan components would remain the same as those listed under All Action Alternatives.

The Western Association of Fish and Wildlife Agencies Wild Sheep Working Group (Wild Sheep Working Group 2012) cautions “that BMPs (best management practices) that work in one situation may or may not work in other situations (Schommer 2009); BMPs need to be developed for site-specific situations, and evaluated for effectiveness.” Alternatives 2, 3, and 5 includes plan component FW-GRZ-S 4, which states, “Domestic sheep allotments shall be managed (e.g., fencing, increased herding, herding dogs, potential vaccine, or other scientifically supported strategies) to mitigate the potential transfer of disease from domestic sheep to bighorn sheep, wherever bighorn sheep occur.” This standard will allow the flexibility to utilize the most appropriate management strategies for site-specific situations to mitigate the potential of disease transmission to bighorn sheep based on site-specific variables concerning topographic features of the landscape, herd dynamics, temporal and spatial information, and other best available science. These strategies could include, but is not limited to, double fencing, converting domestic sheep permits to cattle permits, or vacating the allotment completely. This standard with the other plan components would mitigate the potential for disease transmission to bighorn sheep from domestic sheep or goats, while allowing the flexibility for site-specific information.

Environmental Consequences for Bighorn Sheep – Alternative 4

Alternative 4 incorporates plan components for mitigating the potential for disease transmission to bighorn sheep from domestic sheep or goats. The primary difference between alternative 4 and all other action alternatives is the flexibility of strategies (FW-GRZ-S 4) used to mitigate the potential for disease transmission to bighorn sheep from domestic sheep or goats. All other plan components would remain the same as those listed under All Action Alternatives.

Alternative 4 also includes plan component FW-GRZ-S 4, but it states, “Domestic sheep allotments shall not be authorized within bighorn sheep occupied habitat to mitigate the potential transfer of disease from

domestic sheep to bighorn sheep.” This standard would require domestic sheep to be removed and would not allow the flexibility to utilize the most appropriate management strategies for site-specific situations to mitigate the potential of disease transmission to bighorn sheep. This standard with the other plan components would mitigate the potential for disease transmission to bighorn sheep from domestic sheep or goats.

Summary of All Alternatives for Bighorn Sheep

All alternatives would maintain ecological characteristics that bighorn sheep rely on and would continue to provide ecological conditions needed for bighorn sheep.

The existing 1986 Forest Plan does not include any specific plan direction to mitigate the potential for disease transmission to bighorn sheep from domestic sheep or goats. However, it does include language which would allow opportunities to mitigate the potential for disease transmission to bighorn sheep from domestic sheep or goats. All action alternatives adds fine-filter plan components for the Rocky Mountain bighorn sheep to more clearly direct management emphasis on mitigating the potential for disease transmission to bighorn sheep from domestic sheep or goats. The main differences between the action alternatives in regards to mitigating the potential for disease transmission to bighorn sheep from domestic sheep or goats is the flexibility of strategies (FW-GRZ-S 4) used to mitigating the potential for disease transmission to bighorn sheep from domestic sheep or goats. Alternatives 2, 3, and 5 allow for more flexibility than alternative 4, however all action alternatives include plan components to mitigating the potential for disease transmission to bighorn sheep from domestic sheep or goats.

Cumulative Environmental Consequences for Wildlife, Fish, and Plants

To compare the effects of Carson proposed management to the surrounding landscape, cumulative effects are evaluated considering the management actions of other entities of a similar planning scope within a relevant spatial and temporal context. The analysis area for wildlife includes the Carson, relevant portions of New Mexico Department of Game and Fish, and Northern Region and Bird Conservation Regions 16 (Southern Rockies/Colorado Plateau). This encompasses the counties immediately adjacent to and/or surrounding the Carson and is of a spatial extent that should account for effects on wide ranging species such as big game and migratory birds: animals that can travel across numerous land jurisdictions. The analysis area encompasses similar habitat types as identified in the proposed action area and reflects similar ecological settings that wildlife species referenced in this report could or would use. These effects were evaluated for the life of the plan, approximately 10 to 15 years.

Forest Vegetation Systems

On all managed lands within the cumulative effects analysis area, past management actions, particularly timber harvest and fire suppression, have altered stand structure, composition, function, and connectivity of vegetation communities, particularly in valley-bottoms that were readily accessible and are now in the wildland-urban interface. This resulted in loss of habitat for species particularly within ponderosa pine forests and piñon juniper woodlands, and created additional habitat for species associated with grasslands or hay fields. In the future, increased urbanization and population growth of communities within and surrounding the Carson is expected to lead to increases in forest land clearing and conversion of habitat on private lands; increased loss of open space and loss of connectivity due to development of agricultural lands; and greater need for structure protection with fewer firefighting resources available for other suppression activities. In the future, the development of private property has the potential to increase the disturbance or displacement of those species that are sensitive to human disturbance. For some species, private land development may cause them to shift habitat use to undeveloped lands in the BLM, the Forest, other private timberlands, or State lands. As a result of a growing human population, higher levels of recreational use (both motorized and non-motorized) in areas that previously had low levels of use could also affect species that are sensitive to disturbance during certain times of the year.

Timber harvest, fire suppression, thinning, planting, and wildfires are the past activities that have had the greatest influence on the amount and distribution of forested habitat on NFS lands as well as BLM, state, and private timber lands. These activities have created a variety of successional stages, structures, tree species mixes, and forest patterns that have been neutral for some wildlife species, beneficial to some wildlife species, and detrimental to others.

In the future, fuels reduction activities may occur on all land ownerships, particularly in the wildland-urban interface near private residences. In the past, decades of very active fire suppression led to a build-up of fuels at the same time as more people moved into areas adjacent to and intermingled with NFS lands on the Carson NF. Fire suppression in the frequent fire forest community, in particular, has changed stand structure and led to increased tree densities in forests that were historically more open. In western forests where fire is a dominant disturbance process, restoring a more open understory while maintaining a cohort of trees of large and very large diameter in perpetuity may be an appropriate method for achieving objectives related to wildlife and fire resiliency (J.R. Franklin et al. 1997; Habeck 1990).

In the future, timber harvest occurring on private, state, BLM, or NFS lands may cumulatively affect the quantity and quality of wildlife habitat. The effects to wildlife are difficult to predict because they would depend on a wide variety of factors (e.g., whether habitat that is outside of historical conditions is restored, where wildfires and infestations of insects or diseases occur, the type and location of vegetation treatments). If harvesting moves vegetation toward desired conditions for wildlife, the effects would be beneficial. This could result in better retention of very large size class trees. In the wildland-urban interface, precommercial thinning, timber harvest, and prescribed burning would reduce stand densities, would increase survival of retained trees, and could increase the rate at which very large trees develop. On managed lands, active vegetation restoration actions could mimic natural disturbances in areas where natural disturbances are not compatible with multiple-use objectives of the plan or the objectives of other landowners.

Outside the wildland-urban interface, particularly in high-elevation forest communities, vegetation management standards promote the development of forests in the large and very large size classes containing spruce and subalpine fir in multistoried stands with a dense understory. These forests would be more susceptible to wildfire and would be likely to have higher levels of mortality due to insects and disease (especially for very large Douglas-fir and spruce). The trend of loss of old-growth forest and the very large size class due to wildfire is likely to continue on all lands in these forest types in the future. The desired conditions for vegetation in the plan would maintain or improve the diversity of forested habitats on the Carson NF.

Habitat conditions associated with snow that persists through the spring were not a concern in the past but have become a concern in recent decades due to changes in the timing of snowmelt that have been documented worldwide and in areas of the Carson NF. The most important climate change predictions for this group of species are that the mean monthly minimum temperature (spring and autumn) and the mean monthly maximum temperature (winter) may rise above freezing more months out of the year. Seasonal precipitation is projected to be slightly higher in winter and spring. The combination of these two factors may be beneficial, neutral, or detrimental to these habitats, depending upon whether more precipitation falls as rain or as snow and at what elevations. If the temperature in winter or spring rises above freezing for a more prolonged period of time, snow will not persist as long. However, if increased precipitation falls as snow at high elevations, this could offset the increased melting.

Overall cumulative environmental effects of proposed management under all alternatives in the context of the larger landscape would contribute to the movement of vegetation toward desired conditions, and therefore would improve ecological condition for wildlife species. Proposed management would contribute to landscape restoration, control of invasive species, a reduction in uncharacteristic wildfire across the broader landscape, and the resiliency and adaptability of vegetation communities to climate change. However, the landscape has become more fragmented as a result of activities that include urban

development, ranching, and fire suppression. As a result, there has likely been a net loss of intact, potential habitat and an increased risk to viability for wildlife on adjacent lands; this trend is expected to continue in the future. As a result, the Carson will play an increasing role in the conservation of these habitats and associated wildlife species on NFS lands.

Non-Forested Vegetation Systems

Grass/forb/shrub habitats have shifted from where they occurred historically and are anticipated to continue to shift over time as human settlement and climate conditions change. In the distant past, prescribed fire was used as a tool by Native Americans to create and sustain persistent grass/forb/shrub habitats, especially in valley bottoms in the warm-dry and warm-moist vegetation types where some key wildlife species spent the winter. Subsequently, most valley bottom lands were converted to human developments or agricultural lands. If properly managed, livestock grazing is compatible with maintenance of grass/forb/shrub habitats. Some wildlife species have adapted to these changes and now use agricultural lands that provide grasses and forbs. Even where forested lands were not permanently converted to developments, wildfire exclusion has resulted in succession of grass/forb/shrub habitats, especially adjacent to communities.

Riparian and Aquatic

Historically, much of the private land in the valley bottoms of the Carson was cleared for grazing and farming, reducing native riparian vegetation but maintaining open space used by wildlife. Private land then became more valuable for residential and commercial development, resulting in less open space and less wildlife habitat for many species, especially along streams. This reduces the habitat connectivity in and between riparian areas and upland areas. Developments may also increase human disturbance or loss of wildlife due to vehicle collision as animals move from aquatic and riparian habitats to upland areas. In the future, loss of habitat associated with human developments on some private lands is likely to continue and may increase as the human population within and surrounding the Carson grows.

Historically, wildfires were instrumental slowing upland species encroachment and maintaining dense riparian shrub and deciduous tree communities, but the development of river valleys and adjacent private uplands has placed a high level of emphasis on fire suppression. As more people inhabit areas in and adjacent to riparian areas, there may be more clearing of fuels including riparian species for fire protection on private, NFS, BLM, or state lands. Drought, disease, insects, and/or wildfires may continue to have effects on riparian wildlife habitat on all lands.

Introduction of aquatic invasive species or contaminants in waterbodies resulting from recreational, agricultural, or industrial activities may have negative impacts on species associated with aquatic, wetland, and/or riparian habitats. The potential for introduction of disease and aquatic nuisance species exists on all lands within the cumulative effects analysis area, often as an indirect result of water-based recreation. Many management agencies have increased inspections and public education efforts in recent years to reduce these risks.

All Vegetation

Similar planning efforts are under way on three neighboring forests, the Rio Grande, Cibola, and Santa Fe National Forests. The Santa Fe and Cibola National Forests are revising their land management plans in close coordination with the Carson National Forest and efforts were made to foster cross-plan consistency where possible during plan development. The plans are based upon the same regional vegetative desired conditions, standards, and guidelines, for ponderosa pine and mixed conifer vegetation communities. The cumulative restoration activities from the action alternatives from these plans could have a pronounced effect on modifying stand structure to be less susceptible to stand-replacing fire in these vegetation types, while promoting resiliency regarding climate change. Collectively, the net result of these revised plans

should be positive and beneficial for wildlife species by ensuring the persistence of these habitats into the future and by providing continuity of suitable habitats. This should decrease the overall risk to species viability.

The action alternatives strive to create and maintain natural communities and habitats in the amounts, arrangements, and conditions capable of supporting viable populations of existing wildlife species within the planning area, while contributing to broader landscape scale initiatives where appropriate. As such, species would be better distributed throughout their natural potential range. The adaptive management process and collaborative efforts with partners should also help to inform and realize these conditions on the ground.

Wildlife, Development, and Connectivity

Some wildlife species are especially at risk regarding development. For example: birds, bats, and wide-ranging species can be affected by transmission lines, turbines, roads, and other activities associated with renewable energy infrastructure. These types of activities, which occur on lands of different ownerships and jurisdictions, are anticipated to increase in the future. The Fish and Wildlife Service has issued interim guidelines for site-specific development of wind energy facilities that may affect wildlife (USDI FWS 2012c). On the Carson, proposals for development would be dealt with on a case-by-case basis through special uses and the permitting process.

Blasting of cliffs or rock may occur in the future in relation to activities such as highway widening, but the value of cliffs in providing habitat for bats and other cave-associated species is recognized, so the risk of cliff habitat loss is low. There have been few past impacts to high-elevation talus and boulder habitats on the forest because they are generally within wilderness and inventoried roadless areas.

Caving and rock-climbing are popular recreational activities in some areas and may increase in the future, but these activities require specialized training and/or equipment and they are not likely to increase as rapidly as other types of recreation. Recreational cave and mine exploration on all land ownerships can lead to an increased rate of the spread of diseases such as white-nose syndrome. There is a decontamination protocol in place for cavers on NFS lands, which should aid in slowing the spread on NFS lands, but diseases may continue to be spread elsewhere. Because both people and bats may carry diseases and travel long distances, disease can be spread across a wide area. Disease control requires a cooperative effort. Multiple agencies are monitoring bats, which will help support adaptive management and response to outbreaks.

In the past, many miles of road were built to access Federal, State, and private lands. Forest roads have resulted in direct loss of habitat for some wildlife species. For example, roads have made adjacent areas more accessible for the removal of gathered firewood, and the impact is greatest near communities. Forest roads have also increased human disturbance to some wildlife species. Many miles of forest roads have been decommissioned, closed with gates or berms, or rehabilitated in the last few decades. This has reduced the motorized access for legal hunting and trapping of some wildlife species, the mortality of some species, and the disturbance or displacement of some species. As on NFS lands, effects to wildlife associated with human use of roads will continue on other lands in the future. Administrative use of roads closed to the public that otherwise may have little effect on wildlife, increases during emergency response situations, such as wildfire response, and during timber harvest preparation and implementation. Animals are likely to continue to be killed by vehicle collisions on highways surrounding the Carson.

In the past, the invasion of forest lands by nonnative species has occurred due to a variety of activities, including road building, timber harvest, livestock grazing, and recreational activities. Multiple agencies, counties, and private organizations are involved in educating the public on the importance of preventing the spread of nonnative species, and many agencies engage in management actions to prevent or control infestations.

Existing collaborations between the forest and its partners generally encourage the protection of open lands and the preservation of the land's natural character within local and regional contexts. Cumulatively, these strategies should decrease the potential for future land fragmentation, while improving the overall integrity of the landscape. This should also provide for more resilience regarding climate change for those wildlife species that may need to adjust migration routes, foraging corridors, or breeding grounds.

Climate Change

In general, most climate modelers agree that the Southwest is trending toward prolonged drought. Future potential ecological effects may include an increase in more intense disturbance events such as wildfires, monsoons, and wind. Changing ecological conditions could provide greater opportunities for invasion by nonnative species and disease with the potential to negatively impact various taxa. General trends toward increased moisture deficit could limit overall forest productivity and associated changes in vegetation patterns could affect overall distribution and range of plant and animal species. Cumulatively, these factors would likely impact biodiversity, however to what extent is currently uncertain (USDA FS 2008, 2009a).

Summary

In summary, these cumulative effects, when combined with the preferred alternative, are expected to be beneficial for wildlife by providing more collaborative opportunities through partnerships and better coordination across the landscape. Alternatives 2 through 5 would have similarly positive effects. Alternative 1 (no action) would make the least contribution to cumulative wildlife benefits.

Air Resources

Air is important for forest resources as a requirement for life. Presence of air is a given; however, quality of air is variable and can have effects on forest resources. Air quality can affect visibility, water quality, public health, and ecosystem health. Air quality has long been recognized as an important resource to protect on national forests. Not only does the public value fresh air and sweeping views that good air quality on national forests can provide, but impacts from air pollution can also degrade forest health, water quality, and fisheries that are also highly valued.

The Carson's air quality and its importance to humans and the environment can be measured in three ways: concentrations of pollution in the air, visibility, and deposition of pollution onto the forest. The Forest Service has responsibilities under each of these areas to ensure that specific actions the agency takes on the forest comply with air quality regulations, as well as monitoring impacts on the forest and communicating those impacts to regulatory agencies and other Federal land management agencies for pollution that originates off the forest.

Description of Affected Environment

The existing environment for air resources on the Carson includes current conditions and trends regarding air quality in the plan area. Air resources can be impacted from sources outside of the forest and from sources that originate from the forest. Air resources are addressed in different ways, depending on the source of emissions. Air quality refers to the condition of the air that surrounds us. It is determined through measurement of components of the air, some of which constitute pollutants because they impact human and environmental health. The Clean Air Act, originally adopted in 1963, and amended in 1970, 1977, and 1990, required the Environmental Protection Agency to set National Ambient Air Quality Standards. These standards represent maximum air pollutant concentrations which protect public health and welfare. There are six principal pollutants, called 'criteria' air pollutants. These pollutants include

carbon monoxide (CO), nitrogen dioxide (NO₂), ozone (O₃), sulfur dioxide (SO₂), lead (Pb), and particulate matter (PM₁₀ and PM_{2.5}).¹⁴

National Ambient Air Quality Standards

In general, ambient air quality refers to how much pollution is in the air we breathe. The basic framework for controlling air pollutants in the United States is mandated by the Clean Air Act. The purpose of the Clean Air Act is to protect and enhance air quality, while at the same time ensuring protection of public health and welfare.

For the Carson, there are not many ambient air quality monitoring stations nearby. There is one in Taos which measures PM_{2.5}. Others in northern New Mexico are located in the Four Corners area (O₃, NO₂, SO₂), an ozone monitor in Coyote, NM, and monitors in Santa Fe (O₃ and PM_{2.5}) and Albuquerque. Even though the monitoring locations, with the exception of the ozone monitor in Coyote and the monitor in Taos, are likely more urbanized or impacted by oil and gas emissions, and therefore not entirely representative of conditions on the forest, they all meet Federal and State standards. Lacking other data collected in more remote settings, the reported data are the best available scientific information to characterize existing air quality conditions on the forest. Therefore, this monitoring data depicts concentrations of National Ambient Air Quality Standards, which have the potential to cause adverse health effects in the general population and/or adverse ecological effects.

If an area in a state has air quality worse than the National Ambient Air Quality Standards, it becomes a non-attainment area. Once a non-attainment area meets the standards, it can be designated as a maintenance area. At the present time, the plan area attains all national and New Mexico ambient air quality standards.

Sources of Air Pollution Emissions

Air quality effects on national forests are generally traceable back to the original source of emissions; therefore, air emissions information provides an overview of the magnitude of air pollution and is important in understanding air quality on the forest. Emissions inventories are created by quantifying the amount of pollution that comes from point sources (power plants, factories) and area sources (emissions from automobiles in a city or oil and gas development). Emissions can also originate from natural events like a wildfire. Some of the sources originate within the plan area. Most have their origin outside of the plan area.

For CO, NO₂, and SO₂ emissions, the trend shows a projected decrease in statewide emissions through 2018. Most of the emissions reductions for CO and NO₂ emissions come from fewer mobile source emissions and are associated with the introduction of lower emitting vehicles over time, cleaner transportation fuels, and improvements in vehicle gas mileage. SO₂ emissions show improvement over time largely from reductions in stationary source emissions, such as coal-fired power plants, which are expected, in the near term, to install emission controls defined as best available retrofit technology under the regional haze regulations. Some of the decrease in SO₂ emissions occurs from mobile sources and is associated with cleaner transportation fuels, such as the introduction of low sulfur diesel fuel. The forecasted increase in oil and gas industry activity through 2018 raised expected emissions of NO₂ and SO₂ in the assessment, however these increases were largely unrealized, further decreasing some of the expected emissions decreases described above.

The primary source of particulate matter, both coarse and fine, is from windblown dust across the land and from fugitive dust from anthropogenic sources. However, episodic wildland fire events can be a significant source of fine particulates. Particulate matter levels are expected to increase across New

¹⁴ PM₁₀ is particulate matter 10 micrometers or less in diameter, PM_{2.5} is particulate matter 2.5 micrometers or less in diameter.

Mexico, consistent with the associated land use changes associated with projected population growth in the state. Higher temperatures and persistent drought could exacerbate this trend (Prospero and Lamb 2003).

Adverse air quality impacts on the Carson can usually be traced to air emissions. Knowing the magnitude of emissions and recognizing trends in emissions over time is important because emissions are usually correlated to the type and severity of air quality impacts. Often, adverse air quality impacts to air quality related values can be mitigated through programs that reduce associated air emissions. However, the Forest Service typically lacks direct authority to control air emissions that impact the forest.

Forests play an important role in carbon sequestration, which is the direct removal of CO₂ from the atmosphere through biologic processes, such as forest growth. Carbon sequestration by forests is one way to mitigate greenhouse gas emissions by offsetting losses through removal and storage of carbon (USDA FS 2015c).

Over at least the past several decades, temperate forests have provided a valuable ecosystem service by acting as a net sink of atmospheric carbon dioxide, partly offsetting anthropogenic emissions (Millar and Stephenson 2015). Carbon dioxide uptake by forests in the conterminous United States offset approximately 16 percent of our national total carbon dioxide emissions in 2011 (US EPA 2013). Forests and other ecosystems generally act as carbon sinks because, through photosynthesis, growing plants remove CO₂ from the atmosphere and store it (USDA FS 2015c).

Keeping forests as forests is one of the most cost-effective carbon storage measures, as is restoration which brings back badly disturbed forests and grasslands to producing a full range of environmental services (USDA FS 2015c).

Emission from Plan Area Activities

There are several activities occurring within the Plan Area that have the potential to affect air quality. These are listed in table 46. Wildfire and prescribed fire have the potential for visible short-term effects. Best management practices are used to mitigate effects to air during all activities. In particular, there are specific smoke management guidelines and regulations intended to keep air on the Carson in good condition; however, visibility and air quality may decline if particulate matter increases—a likely result of larger, more severe wildfires as the effects of climate change are realized.

Currently, there are no data on the impact of forest activities on air quality within the plan area. The effect of forest activities on air quality is mitigated using best management practices. Prescribed fire activity is required to use best management practices to reduce the impact of burning on air quality and sensitive populations. The effects of wildfire activity are harder to control and often result in large emission inputs to the air. Air quality monitoring at fixed locations described in this report indicates that overall, air quality standards are being met. These do not measure the impacts of specific activities, however, since no areas are listed as non-attainment in the vicinity of the plan area, none of the activities is contributing to non-attainment of air quality standards.

Air-Quality-Related Values

Air quality-related values are resources that could be impacted by air quality. These values include visibility, human health, water quality, soil quality, and ecosystem impacts. Each air-quality-related value has a “critical load.” The critical load is the amount of a specific pollutant that causes harm to an air quality related value. Under the Clean Air Act, Class I national parks and wilderness areas have to protect air quality related values and consider whether a proposed major emitting facility would have an adverse impact on such values. The Carson manages the Wheeler Peak Wilderness and Pecos Wilderness, both of which are Class I areas that could be affected by projects and sources on or near the forest. In addition, the Carson is near the San Pedro Parks Wilderness and the Bandelier National Monument, which are also

Class I areas. The Carson has a regulatory responsibility to protect air-quality-related values, such as visibility or lichen critical loads, in these Class I areas. To this end, the forest has established critical loads based on a national assessment developing empirical critical loads for major ecoregions across the United States. Data about air quality-related values and critical loads in the plan area are reported in detail in the Carson Assessment Report (USDA FS 2015b).

Table 46. Activities occurring within the plan area that have the potential to affect air quality

Activity	Environmental Effects	Influencing Factors	Forest Level Mitigation
Use of unpaved roads	dust particulates	Varies with volume of traffic, condition of road, fraction of silt in road surface materials, vehicle weight, moisture content of road surface material	Road Management Plan; standards and guidelines; best management practices
Use of paved roads	dust, pollution from brake, tire, and pavement wear, particulates	Varies with amount of traffic, condition of road, temperature, vehicle weight, tire, and surface material. Also, seasonal inputs related to snow/ice controls such as salt and sand.	Road Management Plan; standards and guidelines; best management practices
Motor vehicles including ATVs, snowmobiles.	exhaust, carbon monoxide hydrocarbons, nitrogen oxides particulates, air toxics	Varies with amount of traffic.	Maintain Forest Service motor vehicles; no control over non-Forest Service motor vehicles, local, state, and Federal regulations will mitigate
Wildland fire management	smoke particulates, carbon monoxide, volatile organics, nitrogen oxides, carbon dioxide, air toxics	Varies with intensity and rate of fire, fuels type, topography,	Fire management plan and associated mitigations; burn plans; best management practices in accordance with smoke management techniques and requirements
Construction and building activities	dust exhaust, particulates, carbon monoxide hydrocarbons, nitrogen oxides, carbon dioxide	Varies with size of equipment, size of area, weather conditions during activity,	standards and guidelines, contract provisions, best management practices
Oil and gas	methane, volatile organics, nitrogen oxides, air toxics	Varies with amount of development, types of operations, and climatic patterns.	standards and guidelines, contract provisions, best management practices

Summary

The ecosystem services provided by air are generally stable and not at risk. Air quality on the Carson is within regulatory levels for National Ambient Air Quality Standards and the trend based on projected emission inventories appears to be stable or is improving for most pollutants (table 47). This is also true regarding visibility conditions. The main challenge could be with regard to both coarse and fine particulate matter, which can affect both the ambient air quality and visibility on the Carson. Land use both on and off the forest, as well as climate change and drought, can contribute to windblown and fugitive dust. Wildfires can also be a significant source of particulate matter.

There is some indication that current levels of nitrogen deposition have exceeded critical loads and are significant enough to have resulted in impacts to lichen diversity and community structure and to a lesser degree to herbaceous plants and shrubs, forests, and nitrate leaching. However, these results were based on modeled critical loads and have not been verified on the Carson. The rate of deposition of nitrogen,

which can lead to impacts affecting forest health, appear to be decreasing based on projected emissions at the state level. Modeled results also indicate that the levels of acid gases are not at levels significant enough to result in impacts to either soils or surface water. There are no direct measurements on the forest that indicate otherwise.

There is some indication that mercury deposition at higher elevations on the Carson may be significant, however atmospheric mercury, based on regional emissions, is also expected to decrease.

Table 47. Summary of conditions, trends, and reliability of air quality measures and critical loads (deposition)

Category	Air Quality Measure	Current Conditions	Trend	Reliability
NAAQS	CO	good	improving	high
NAAQS	NO ₂	good	improving	high
NAAQS	SO ₂	good	stable	high
NAAQS	Pb	good	stable	high
NAAQS	O ₃	good	stable	high
NAAQS	PM _{2.5}	good	stable to declining	high
NAAQS	PM ₁₀	good	stable to declining	high
Visibility	Visibility	departed	stable to improving	high
Nitrogen Eutrophication	Critical loads deposition: lichens	potentially at risk	improving	moderate
Nitrogen Eutrophication	Critical loads deposition: herbaceous plants & shrubs	potentially at risk	improving	low
Nitrogen Eutrophication	Critical loads deposition: mycorrhizal fungi	good	improving	low
Nitrogen Eutrophication	Critical loads deposition: forests	potentially at risk	improving	low
Nitrogen Eutrophication	Critical loads deposition: nitrate leaching	potentially at risk	improving	low
Acid Deposition	Critical loads deposition: soils	good	improving	low
Acid Deposition	Critical loads deposition: surface water	good	improving	low
Deposition (other)	Critical loads deposition: mercury	potentially at risk	improving	low

Abbreviations as follows: carbon monoxide (CO), nitrogen dioxide (NO₂), ozone (O₃), sulfur dioxide (SO₂), lead (Pb), and particulate matter (PM₁₀ and PM_{2.5}). NAAQS indicates relative to National Ambient Air Quality Standards. Visibility is relative to 2064 Regional Haze Goal.

Environmental Consequences for Air Resources

Methodology and Analysis

The potential effects to air quality from direction given in the no-action alternative (alternative 1) are compared to those under the action alternatives (alternatives 2, 3, 4 and 5). Several activities that could occur on the Carson could be sources of potential emissions as shown in table 46. Of these activities, emissions from prescribed fire and naturally ignited wildfire managed for resource benefit are the only effect that varies by alternative. These effects are modeled and are analyzed in further detail. Emissions related to the other activities that produce emissions on the forest would not vary greatly by alternative. These are discussed qualitatively below.

Emissions for CO₂ and PM_{2.5} (fine inhalable particles, with diameters that are generally 2.5 micrometers and smaller) were modeled for the objectives for prescribed fire and naturally ignited wildfire managed for resource benefit that vary for each alternative as shown in figure 17 and figure 18. Emissions from fire is the only effect analyzed quantitatively for air quality because emissions from this activity far outweigh all other possible emissions. PM_{2.5} was modeled due to the concern about impacts to public health, National Ambient Air Quality Standards, and visibility. CO₂ was modeled due to its contribution to climate change. For each alternative, the upper target range of acres in the ranges for objectives were used in the model.

Consume, version 4.2 (USDA FS 2015b), was used to model smoke emissions from the four action alternatives and the no-action alternative. Consume is a fuels model commonly used to estimate smoke emissions. Basic input data, such as fuel types, the type of fire (prescribed fire or naturally ignited wildfire managed for resource benefit), the condition of the unit (has it been mechanically treated), and environmental conditions (fuel moisture) are entered into the model. The model then estimates emissions for a variety of pollutants, such as PM_{2.5} and CO₂. Objectives under each alternative define a range of treatment acres for prescribed fire and naturally ignited wildfire managed for resource benefit. To bound the analysis, the alternatives were modeled based on the high end of the objectives for treatment between alternatives to estimate annual emissions. However, treatment objectives may not be met, and actual acres treated would vary. Fuels moistures were used consistent with conditions in which prescribed fire or wildfires would take place. For each fuel type, it was assumed that fire suppression and grazing had affected fuel loads by increasing standing biomass compared to what would be available to burn under a natural fire regime. A complete set of assumptions and outputs for all pollutants modeled is in the project record (Hall 2018).

Indicators

- Modeled emissions of CO₂ and PM_{2.5} based on acres of prescribed fire and naturally ignited wildfire managed for resource benefit.

Assumptions

- Sources of ambient pollution other than fire, produce emissions on the forest that would not vary greatly by alternative.
- Air quality would continue to meet or exceed State and Federal ambient air quality standards.
- Practices such as thinning and prescribed fire may release carbon in the short term, but they focus future growth and carbon storage on trees that are at lower risk and/or are more resilient to disturbance (Hurteau 2017; Hurteau et al. 2016; McCauley et al. 2019).
- High-severity fire has the potential to be a carbon source for decades post fire compared to 2 to 3 years post treatment from prescribed fire (Dore et al. 2008). Because live trees continually sequester carbon and are a more stable carbon sink than dead biomass left on the site, treating stands is preferred for long-term mitigation of atmospheric carbon levels (Vegh et al. 2013).
- Management activities would not adversely impact Class I airshed visibility as established in the Clean Air Act.

Environmental Consequences for Air Resources Common to All Alternatives

Vehicle emissions associated with roadwork, administrative use, on- and off-road travel, and recreational vehicle use release combustion gases (exhaust) and particulates into the air, which contribute to ambient concentrations of pollutants regulated by the National Ambient Air Quality Standards. Most of these emissions are confined locally, are temporary, and are not expected to negatively affect ambient concentrations, which are currently very good. Due to the high level of uncertainty associated with any

analysis of these emissions, and since they are relatively insignificant, they are unlikely to vary substantially between alternatives, and are unlikely to have a negative effect on meeting any regulatory standards or on visibility or deposition of pollutants, these emissions were not analyzed.

Roads, motorized trails, and gravel pits produce fugitive dust, but it is not expected to have a significant impact on air quality, nor vary between alternatives. Impacts from these types of emissions were not directly analyzed. There is a high degree of uncertainty associated with such an analysis, and the air quality in the project area is very good, such that the relatively small amount of emissions from these actions would be considered negligible to the broader airshed. Any actions such as building roads, or the use of gravel pits are likely to last for a very short period of time, a few months rather than years, and the dust would be isolated to small areas and would not pose a threat to visibility or air quality standards. In addition, fugitive dust from the construction, operation, and maintenance of roads could be reduced by Federal contract requirements dictating standard specifications and best management practices to reduce fugitive dust, if deemed necessary for a particular contract.

Mechanical treatment of vegetation is used to reduce high concentrations of fuels in the forest understory, which, in turn, lowers the risk of severe wildfire and its effects on the health and safety of fire management personnel, and improves habitat for a variety of species. It is often used in advance of planned fire ignitions to remove the woody debris and plant material on the forest floor. Operation of chainsaws and chippers releases exhaust and particulates to the air, and burning the larger branches, twigs, and other woody debris, referred to as “slash,” generates smoke, the effects of which are discussed below. Due to the high level of uncertainty associated with any analysis of equipment emissions, and since they are relatively insignificant, they are unlikely to vary between alternatives, and they are unlikely to have a negative effect on any regulatory standards, visibility or deposition of pollutants, these emissions were not analyzed.

Oil and gas development and production currently occurs on the forest within the Jicarilla Natural Gas Management Area and includes a wide variety of operations including compressor stations, wells, gas lines, and storage tanks. These processes release several types of emissions, including methane (a greenhouse gas), volatile organic compounds (VOCs) which are precursors to ozone, nitrogen oxides, and others. Generally, these emissions are controlled by best management practices required under individual leases and by State and Federal law. At current levels of oil and gas development, the direct and indirect emissions, including dust and vehicle emissions, are not resulting in significant effects on the forest and were not modeled in this analysis.

Under all alternatives, wildland fires would continue to occur within the plan area and would be managed according to policy and guidance set forth under each alternative. Smoke from wildland fires may travel large distances, impairing local and regional visibility and degrading air quality far from its point of origin, depending on topography and atmospheric conditions—in particular, wind speed and direction. In the case of wildfire, ambient concentrations of criteria pollutants may increase beyond the National Ambient Air Quality Standards, both locally and in distant locations potentially in other states, under any alternative. The occurrence of wildfire is expected to increase, regardless of forest activities, due to an increase in drought and higher temperatures. Thus, any adverse health effects on sensitive populations would be similar for all alternatives.

The current 1986 plan (alternative 1) requires that every forest action be designed to comply with all applicable air quality regulations. It also specifies that best management practices be applied to activities that generate air pollutants to reduce or mitigate potential adverse impacts. All the action alternatives propose equivalent air quality protection. Therefore, there is no difference among the alternatives regarding protection of ambient air quality and effects on human health.

Environmental Consequences for Air Resources – Alternative 1

Alternative 1 represents no change to current management and is described in the affected environment. Modeled emissions for this alternative represent baseline conditions that alternatives 2 through 5 are compared with. Currently, the Carson treats up to 13,500 acres per decade with prescribed burns. In addition, under current management, an average of approximately 1,300 acres have been treated with naturally ignited wildfire managed for resource benefit annually. It is possible more acres could be treated in any one year, depending on conditions.

Based on these acreages, the modeled emissions are 211,740 tons of CO₂ and 1,100 tons of PM_{2.5} annually. To put these numbers in perspective, the PM_{2.5} emissions are about equal to the emissions of an average coal-fired power plant annually (CEC 2011). Regarding the CO₂ emissions, a typical coal power plant generates approximately 3.5 million tons of CO₂ per year (UCS 2017), which is approximately 16 times greater on an annual basis than the annual emissions from wildland fire in this alternative. Treatments would provide some minor offsetting of carbon emissions through sequestration.

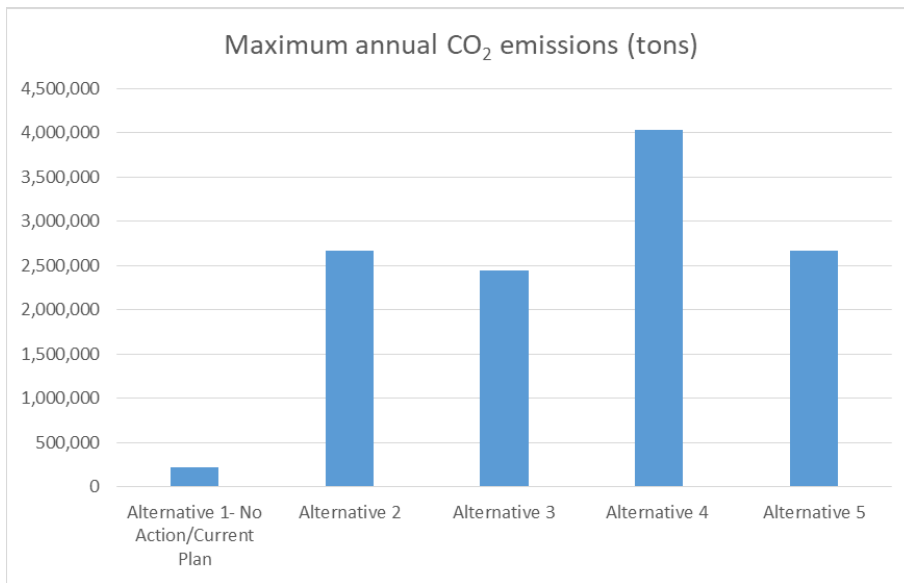


Figure 17. Maximum annual CO₂ emissions from wildfire by alternative (tons)

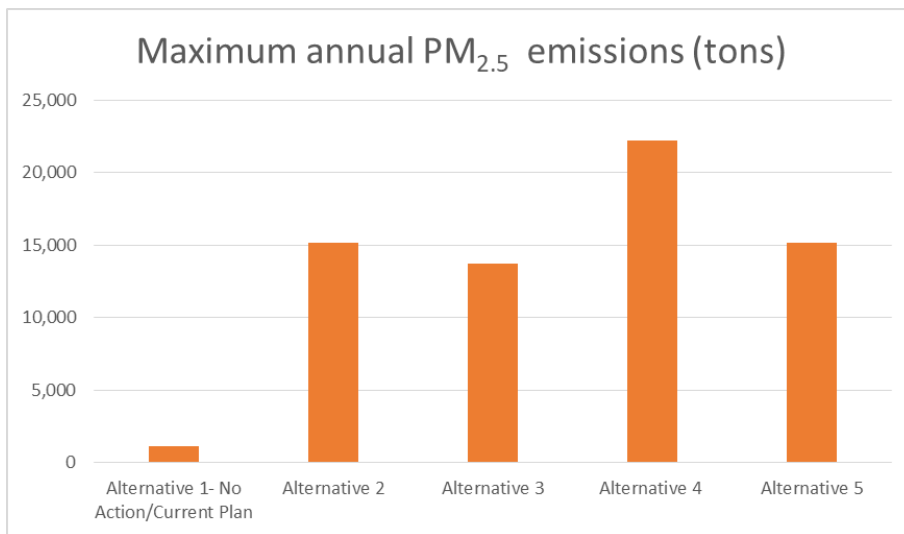


Figure 18. Maximum annual PM_{2.5} emissions from wildfire by alternative (tons)

Environmental Consequences for Air Resources Common to Alternatives 2, 3, 4, and 5

Alternatives 2, 3, 4, and 5 provide additional direction that emphasizes meeting or surpassing State and Federal ambient air quality standards; ensuring that there are no measurable disturbances to water chemistry or biotic components due to atmospheric deposition of pollutants; maintaining or improving visibility; and ensuring that sensitive areas and receptors are not negatively impacted by smoke. These would be accomplished by coordination and permitting with agencies, organizations, Tribes, stakeholders and other entities to actively pursue actions designed to reduce the impacts of pollutants from sources both within and outside the Carson, monitoring of critical loads on the forest so that deposition levels can be communicated to regulators, and managing smoke in conjunction with the State of New Mexico through compliance with its Smoke Management Programs. These actions would better align forest management with the goals and objectives of the Clean Air Act and its amendments, the Regional Haze Rule, and New Mexico state implementation plans.

Environmental Consequences for Air Resources Alternative 2

Alternative 2 proposes to treat up to 82,500 acres with prescribed fire and 82,500 acres with naturally ignited wildfire managed for resource benefit every 10 years. Total CO₂ emissions from alternative 2 would be 2,666,180 tons a year. This is more than 12 times more CO₂ emissions when compared to alternative 1. PM_{2.5} emissions would be 15,168 tons a year, which is more than 13 times more emissions than the current plan (table 46 and table 47). Under this alternative approximately 11 times more acres would be treated with fire than under the current plan.

The effects of the proposed forest treatments in the management objectives for alternative 2 on emissions of PM_{2.5} and CO₂ over time are uncertain but could be significant, especially regarding the emissions of these pollutants produced from wildfire. The emissions presented in figure 17 and figure 18, represent estimated direct emissions from treatment options, and not the indirect and avoided emissions associated with this alternative. For example, the PM emissions do not represent the emissions from a wildfire that may occur following treatment which would result in less emissions (due to the removal during treatment of material that produces emissions) nor does it represent the emissions that could occur from a wildfire in an area that has not had treatment that would likely result in greater emissions due to the similar fuel loading but hotter dryer conditions that are likely to occur during a wildfire. Due to the high level of uncertainty in these scenarios, no quantitative analysis was conducted, but these effects can be described qualitatively, especially for CO₂ emissions where the indirect effects are more certain.

Alternative 2 would restore approximately 11 times more acres annually than the current plan, which would result in greater potential for carbon sequestration over the life of the plan. Although this strategy initially reduces carbon stocks, it can lower risk for greater carbon stock losses and emissions in the future (Wiedinbyer and Hurteau 2010).

Environmental Consequences for Air Resources – Alternative 3

Alternative 3 proposes to treat up to 162,000 acres with prescribed fire and no acres with naturally ignited wildfire managed for resource benefit. Total modeled CO₂ emissions from alternative 3 are 2,440,898 tons a year. This is about 11 times more CO₂ emissions from alternative 1. PM_{2.5} emissions are estimated at 13,712 tons a year, or about 12 times more emissions of PM_{2.5} than the current plan. While the total acres with fire are the same as in alternative 2, the emissions are less because more acres are treated with prescribed fire which creates less emissions than wildfire. Under this alternative approximately 11 times more acres would be treated with fire than under the current plan.

Alternative 3 includes the same plan direction as alternative 2 and impacts on air quality from management objectives other than emissions from fire would not be expected to vary greatly between any of the alternatives.

As in alternative 2, the effects of emissions are highly uncertain but potentially significant in alternative 3. Alternative 3 would restore approximately 11 times more acres annually than the current plan, which would result in greater potential for carbon sequestration over the life of the plan.

Environmental Consequences for Air Resources – Alternative 4

Alternative 4 proposes to treat up to 112,500 acres with prescribed fire and 112,500 acres with naturally ignited wildfire managed for resource benefit. Total modeled CO₂ emissions from alternative 4 would be 4,027,645 tons a year. This is 18 times more CO₂ emissions than alternative 1. PM_{2.5} emissions are modeled at 22,228 tons a year, or nearly 20 times more PM_{2.5} emissions than the current plan. (table 46 and table 47) This alternative treats approximately 15 times more acres with fire than the current plan.

Alternative 4 includes the same plan direction as alternative 2 and impacts on air quality from management objectives other than emissions from fire would not be expected to vary greatly between any of the alternatives.

As in alternatives 2 and 3, the effects of emissions are highly uncertain but potentially significant in alternative 4. Alternative 4 would restore approximately 15 times more acres annually than alternative 1, which would result in greater potential carbon sequestration over the life of the plan.

Environmental Consequences for Air Resources – Alternative 5

In terms of effects, the emissions associated from alternative 5 are identical to alternative 2 (see description above).

Cumulative Environmental Consequences for Air Resources

Cumulative effects are changes to air quality-related values on the forest as a result of cumulative inputs to the air. These inputs occur from within the plan area as well as outside of the plan area, including global sources. Effects to air quality-related values are the result of cumulative input to the air from multiple sources, within and outside the plan area. Cumulative effects from prescribed fire and wildland fire management on Federal, State, and tribal lands are largely addressed by the New Mexico State Implementation Plan (20.2.65.1 NMAC). Table 47 shows that while some current values are “good” to “potentially at risk,” the trend for all values is expected to improve.

The cumulative effects area for air resources is primarily the area within 300 kilometers (186 miles) of the Carson. However, emissions that can lead to impacts on the forest can originate both in other states farther than 300 kilometers (186 miles) away and from other countries thousands of kilometers (miles) away, from wildfires, dust, or emissions from fossil fuel burning. The non-forest sources of emissions listed below include the main sources of emissions and are consistent across all alternatives.

- Off-forest sources of emissions that may contribute additively to cumulative effects are those that would disturb soils, such as residential and commercial development, energy production and development, and road construction. Vehicle travel on adjacent roads and highways and agricultural activities (which produce exhaust gases and fugitive dust), industrial facilities from which point-source (e.g., smokestack) pollutant emissions are released, and smoke from fires on land under private or other agency jurisdiction also contribute to cumulative effects. Of these, the activities most likely to contribute to cumulative air quality, when considered additively with forest actions, are wildland fire on adjacent lands, and fugitive dust, energy production, and vehicle emissions.
- Population growth and development in New Mexico is expected to continue over the life of the plan. Areas adjacent to the forest are expected to continue to grow. With projected growth, new construction of residential and commercial developments and roads is likely, and new ground disturbances would contribute additional fugitive dust to the ambient air. Likewise, an influx of more

people would trigger more vehicle travel on local roads, increasing exhaust and dust emissions in the area. Future proposed actions on the forest would be evaluated to determine if, when added to non-forest sources, they would exacerbate attainment or increase haze and decrease visibility in both the local airshed and in Class I areas.

- Industrial sources of air pollutants near the forest include power plants, factories, and other facilities that release pollutants from a single point. Air emissions from each of these are regulated under permits by the state and local environmental agencies. Therefore, if new significant sources of this kind are proposed, the increment of criteria pollutants, greenhouse gases, and hazardous substances would be reviewed by regulators. Mitigation and monitoring would be required to ensure continued attainment of the National Ambient Air Quality Standards.
- Emissions for oil and gas development on the forest is not a significant issue at current levels and is controlled by current best management practices, standards and guidelines, lease and contractual requirements, and state and Federal law. If development significantly increases, the increment of criteria pollutants, greenhouse gases, and hazardous substances would need to be reviewed by the forest and regulators. Mitigation and monitoring may need to be required to ensure continued attainment of the National Ambient Air Quality Standards.
- Planned and unplanned fire ignitions may produce smoke, from which primary, secondary, and hazardous pollutants are released to the atmosphere. Planned ignitions are applied under the direction of a Federal, state, or local land management agency after consideration of variables such as weather, acreage to be treated, type and condition of fuels, and duration, among other factors. Authorization for planned ignitions by the State of New Mexico is based, in part, on consideration of the potential for cumulative effects from smoke and other activities planned during a concurrent timeframe. Therefore, the potential for significant cumulative effects from planned ignitions is largely avoided or, in some cases, mitigated by adherence to the Smoke Management Program in the state implementation plan.
- The occurrence and extent of wildfires are not predictable, and when uncharacteristic fires occur, their high intensity may result in temporary violations of the National Ambient Air Quality Standards in the affected airshed(s). The effects of wildfires are not considered additive with planned forest activities because they are unplanned events.

Conclusion

Under each alternative, the potential for significant air quality impact could occur, due to wildland fire. Alternatives 2, 3, 4 and 5 are improvements over the current plan in that added direction is included in all four that would improve the management of air quality on the forest in terms of impacts from wildland fire and monitoring of critical loads. Alternatives 2, 3, 4 and 5 have potential direct emissions that are 11 to 20 times more than the current plan, depending on the alternative. The potential indirect effects from CO₂ emissions through carbon sequestration could reduce CO₂ emissions when compared to the current plan. While highly uncertain, the potential reduction in CO₂ emissions from management activities between alternatives is proportional to the acres treated. As a result, while all would be improvements to the current plan, the greatest potential is in alternative 4. Alternatives 2, 3, and 5 are equivalent. There are significant uncertainties between all alternatives in terms of the effects on air quality including CO₂ emissions due to the unknowns such as climate and the amount of wildland fire that may occur.

Carbon

Forests are dynamic systems that naturally undergo ebbs and flows in carbon storage and emissions as trees and other vegetation establish and grow, die with age or disturbances, and re-establish and regrow. Through photosynthesis, growing plants remove CO₂ from the atmosphere and store it in forest biomass, such as in plant stems, branches, foliage, and roots. Forests are generally most productive when they are

young to middle age, then productivity peaks and declines or stabilizes as the forest canopy closes and as the stand experiences increased respiration and mortality of older trees (He et al. 2012; Pregitzer and Euskirchen 2004). Some of this organic material is eventually stored in forest soils through biotic and abiotic processes (Ryan et al. 2010). Carbon can also be transferred and stored outside of the forest ecosystem in the form of wood products, further influencing the amount of carbon entering the atmosphere (Gustavsson et al. 2006; Skog et al. 2014). Many management activities initially remove carbon from the forest ecosystem, but they can also result in long-term maintenance or increases in forest carbon uptake and storage by improving forest health and resilience to various types of stressors (McKinley et al. 2011).

Description of Affected Environment

The carbon legacy of the Carson NF is tied to the history of Euro-American settlement, land management, and disturbances. The national forest accumulated carbon rapidly from the early 1900s through the 1970s because of regrowth following disturbances and heightened productivity of young to middle-aged forests (30 to 60 years old). Stand establishment declined between 1970 and 2010, because of drought and older stands reaching slower growth stages in the 1970s, causing the rate of carbon accumulation to decline by the mid-1980s. From 1990 to 2011, fire has been the main disturbance affecting carbon stocks, causing a 2 percent decline in forested area (Dugan et al. 2020).

Forests on the Carson NF have increased carbon stocks from 56.4 ± 8.2 teragrams of carbon (Tg C) in 1990 to 56.9 ± 7.3 Tg C in 2013, just a 0.9 percent increase in carbon stocks over this period (Dugan et al. 2020)¹⁵. The stability in carbon storage is related to the age of trees on the Carson NF. Most stands are middle-aged and older (over 80 years old) and there has been a decline in new stand establishment in recent decades (Birdsey et al. 2019).

According to satellite imagery, fire (wildfire and prescribed) was the dominant disturbance type on the Carson NF from 1990 to 2011. The area burned was relatively small, affecting on average just 0.09 percent of the Carson NF's forested area annually (about 470 hectare (ha) per year). Corresponding carbon losses from the forest ecosystem associated with fire have also been relatively small, with non-soil losses from 1990 to 2011 totaling 0.4 Mg C per ha or about 0.5 percent of non-soil carbon stocks (Birdsey et al. 2019). Given that Carson NF contains about 513,688 ha total, non-soil carbon losses from fire have been about 9,785 Mg C per year (0.0098 Tg C yr⁻¹) (Dugan et al. 2020).

Insects affected on average 0.02 percent of forested area annually (about 115 ha) on the Carson NF from 1990 to 2011. Overall, insect disturbance detected over this 21-year period resulted in the loss of approximately 0.14 Mg C per ha (0.2 percent) of non-soil carbon. This is equivalent to an estimated loss of about 0.0034 Tg C per year, an extremely small fraction of the total carbon stocks on the Carson NF (Dugan et al. 2020).

Timber harvest also affected an average of 0.02 percent of forested areas annually (about 85 ha) from 1990 to 2011. Timber harvest resulted in the loss of approximately 0.05 Mg C per ha (0.1 percent) of non-soil carbon. This is equivalent to an estimated loss of about .0012 Tg C per year, an extremely small fraction of the total carbon stocks on the Carson NF (Birdsey et al. 2019). These estimates do not account for continued storage of harvested carbon in wood products or the effect of substitution. Recent declines in timber harvesting have slowed the rate of carbon accumulation in the product sector (Dugan et al. 2020).

Warmer temperatures and lack of precipitation have stressed forests, causing a negative impact on carbon accumulation since the 1990s. Conversely, increased atmospheric CO₂ and nitrogen deposition have

¹⁵ See environmental impact statement appendix C for a complete description of the modeling process.

potentially enhanced growth rates and helped to counteract ecosystem carbon losses from disturbance, aging, and climate (Dugan et al. 2020).

Environmental Consequences for Carbon

Methodology and Analysis

The carbon assessment draws largely from two recent U.S. Forest Service reports: the Baseline Report (USDA FS 2015a) and the Disturbance Report (Birdsey et al. in press). These reports provide assessments of forest ecosystem and harvested wood product carbon stocks and flux, and the factors that have influenced carbon dynamics. The Resource Planning Act assessment (USDA Forest Service 2016) and a regional vulnerability assessment (USDA FS 2010c, 2014a) also provide information on potential future carbon conditions. These reports incorporate advances in data and analytical methods and collectively represent the best and most relevant scientific information available for the Carson NF.

Potential carbon effects are discussed qualitatively, with supporting estimates where possible by drawing on the quantitative analysis of the impacts of past management activities on forest carbon stocks and fluxes, as well as through future-looking analysis where available (Dugan et al. 2020).

This analysis considers the following:

- The potential impacts of climate change on the Carson NF as indicated by consideration of changes in climate (e.g., temperature and precipitation patterns) and the effects of climate change impacts on ecological, social, and economic resources; and
- The potential effects of management actions on climate change as indicated by consideration of changes in carbon sequestration and storage arising from natural and management driven processes.

Indicators

- Carbon pools (carbon stocks), carbon uptake, and CO₂ emissions
- Natural and human-caused influences on carbon stocks, uptake, and emissions

Assumptions

Carbon dioxide emissions are projected to increase through 2100 under even the most conservative emission scenarios (IPCC 2014). Several models project greater increases in forest productivity when the CO₂ fertilization effect is included in modeling (Aber et al. 1995; Ollinger et al. 2008; Pan et al. 2009; Zhang et al. 2012). However, the effect of increasing levels of atmospheric CO₂ on forest productivity is transient and can be limited by the availability of nitrogen and other nutrients (Norby et al. 2010). Productivity increases under elevated CO₂ could be offset by losses from climate-related stress or disturbance.

Given the complex interactions among forest ecosystem processes, disturbance regimes, climate, and nutrients, it is difficult to project how forests and carbon trends will respond to novel future conditions. The effects of future conditions on forest carbon dynamics may change over time. As climate change persists for several decades, critical thresholds may be exceeded, causing unanticipated responses to some variables like increasing temperature and CO₂ concentrations. The effects of changing conditions will almost certainly vary by species and forest type. Some factors may enhance forest growth and carbon uptake, whereas others may hinder the ability of forests to act as a carbon sink, potentially causing various influences to offset each other. Thus, it will be important for forest managers to continue to monitor forest responses to these changes and potentially alter management activities to better enable forests to better adapt to future conditions.

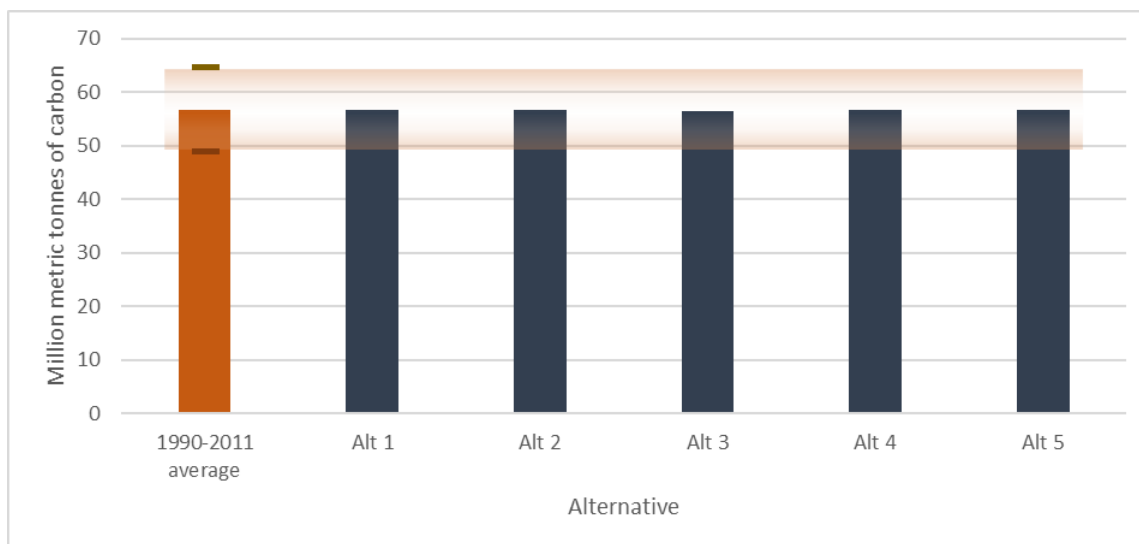
Environmental Consequences for Carbon Common to All Alternatives

All action alternatives provide the same desired conditions for terrestrial ecosystems, and the standards and guidelines that help achieve or maintain those conditions. These proposed activities will help maintain critical ecosystem functions into the future, in part by balancing the maintenance of carbon stocks and rates of carbon uptake.

All the proposed management activities would initially directly reduce carbon stocks on the forest, though minimally. This initial effect would be mitigated or even reversed with time, reducing the potential for negative indirect and cumulative effects. These short-term losses and emissions are small relative to both the total carbon stocks on the forest and national and global emissions. Further, the proposed activities would generally maintain and improve forest health and supply wood for forest products, thus having positive indirect effects on carbon storage. The Carson NF will continue to be managed to maintain forests as forests and to maintain the many ecosystem services and co-benefits that forests provide, including carbon uptake and storage.

Environmental Consequences for Carbon – Alternative 1

Under alternative 1, timber harvest and fire disturbance would remain similar to recent trends and would result in a similar pattern of carbon storage and flux as described in the Affected Environment section above. Recent levels of timber harvest have increased since the 1990 through 2011 reference period. In recent years, timber harvests have averaged 1,349 acres per year, or about 6.5 times the annual amount during the reference period. Assuming that, the annual carbon impact also increases up to 6.5 times above reference period levels, harvest treatments under alternative 1 may result in a maximum removal of about 7,817 Mg/ha of carbon per year (0.0078 Tg C) from aboveground pools. Levels of disturbance from fire and insects have been similar to the reference period since 2011, and their effects would be similar to those described for the reference period. With little mechanical treatment or prescribed fire, the recent decline in new stand establishment is likely to continue. As forest stands continue to age toward middle-aged to older more will reach slower growth stages in coming years, potentially causing the rate of carbon accumulation to decline.



Dark bars around the 1990 to 2011 average and shading represent the 95 percent confidence interval for recent total carbon stocks (Dugan et al. 2020).

Figure 19. Lost potential storage of carbon because of disturbance on the Carson NF by alternative, compared to average carbon stocks between 1990 and 2011

Environmental Consequences for Carbon – Alternatives 2 and 5

Alternatives 2 and 5 include the same objectives for acres of mechanical and fire treatment, thus they are projected to have similar effects on carbon. Compared to alternative 1, alternatives 2 and 5 would impact more area based on objectives for treatment in frequent fire forest types (FW-MCD-O-1, FW-MCD-O-2, FW-PPF-O-1, and FW-PPF-O-2).

The maximum treatment area for harvests and thinning under alternatives 2 and 5 would be approximately 4,000 acres per year, or about 0.2 percent of total forested area on the Carson NF. This is an increase of about three times the annual harvest area compared to alternative 1, and nineteen times harvest levels in 1990 to 2011. Assuming that the annual carbon impact also increases up to nineteen times above past levels, harvest treatments under alternatives 2 and 5 may result in a maximum removal of about 23,295 Mg per ha of carbon per year (0.0233 Tg C) from aboveground pools (Dugan et al. 2020).

Alternatives 2 and 5 also include a twelve-fold increase (compared to the reference period) in prescribed burning and wildfires managed for resource benefit (up to 13,500 acres annually). If that level of prescribed burning is achieved, it would result in a potential loss of about 113,779 Mg C annually (0.1138 Tg C), based on the historical analysis (Dugan et al. 2020). However, the historical period included wildfires, which generally burn at higher severities and result in greater carbon losses than prescribed burns. By reducing hazardous fuels, additional prescribed burning may indirectly reduce the risk of more severe wildfires and the resulting higher carbon losses in the future (Agee and Skinner 2005; Wiedinmyer and Hurteau 2010).

Considering the maximum area treated with harvesting and prescribed fire, the amount of carbon that might be removed is small relative to the approximately 56.9 million metric tonnes (Tg) of carbon stored in the forest ecosystem of Carson NF. With maximum intensification, potential management actions would affect up to 1.2 percent of the forested area and approximately 0.1405 Tg C annually. The actions under alternative 2 or 5 would not significantly, adversely, or permanently affect forest carbon storage, but would rather achieve a more resilient forest condition that would improve the ability of the Carson NF to maintain carbon stocks and enhance carbon uptake (Dugan et al. 2020).

The total annual lost carbon storage potential would be slightly greater than under alternative 1, though still small compared to the total carbon stocks on the forest and within the uncertainty for measurement of total forest carbon stocks (figure 19). Lost storage potential is likely to be offset by an increased rate of carbon accumulation due to younger forest establishment following disturbance.

Environmental Consequences for Carbon – Alternative 3

The maximum treatment area for harvests and thinning under alternative 3 would be approximately 10,400 acres per year, or about 0.7 percent of total forested area on the Carson NF. This is an increase of about 2.5 times the annual harvest area compared with alternative 2. Assuming that the annual carbon impact also increases two and a half times above alternative 2, harvest treatments under alternative 3 may result in a maximum removal of about 60,568 Mg/ha of carbon per year (0.0606 Tg C) from aboveground pools (Dugan et al. 2020).

Alternative 3 includes the same acreage (up to 13,500 acres annually) of prescribed and wildfire managed for resource benefit as alternative 2, which is 11.5 times the amount under alternative 1. If maximum levels of prescribed burning are achieved, this would result in a potential loss of about 113,779 Mg C of carbon annually (0.1138 Tg C), as estimated from the historical analysis (Dugan et al. 2020). However, the historical period included wildfires which generally burn at higher severities and result in greater carbon losses than prescribed burns. By reducing hazardous fuels, additional prescribed burning up to maximum levels described in Tier 2 may indirectly reduce the risk of more severe wildfires and greater carbon losses in the future (Agee and Skinner 2005; Wiedinmyer and Hurteau 2010).

Considering the maximum area treated with harvesting and prescribed fire, the amount of carbon that might be removed is small relative to the approximately 56.9 million metric tons (Tg) of carbon stored in the forest ecosystem of Carson NF. With maximum intensification, potential management actions would affect up to 1.6 percent of the forested area and 0.1777 Tg C annually. The alternative 3 actions would not significantly, adversely, or permanently affect forest carbon storage, but would rather achieve a more resilient forest condition that would improve the ability of the Carson NF to maintain carbon stocks and enhance carbon uptake (Dugan et al. 2020).

The total annual lost carbon storage potential would be slightly greater than under alternative 2, though still small compared to the total carbon stocks on the forest and within the uncertainty for measurement of total forest carbon stocks (figure 19). Lost storage potential is likely to be offset by an increased rate of carbon accumulation due to younger forest establishment following disturbance.

Environmental Consequences for Carbon – Alternative 4

The maximum treatment area for harvests and thinning under alternative 4 would be approximately 930 acres per year, a negligible percentage of total forested area on the Carson NF in terms of carbon flux. This is a decrease of more than four times the annual harvest area compared to alternatives 2. Compared to alternative 1, harvests under alternative 4 decrease removal of carbon by about a third, assuming that the annual carbon impact increases proportionally. Mechanical treatment and removal under alternative 4 would result in a maximum potential removal of about 5,416 Mg/ha of carbon per year (0.0054 Tg C) from aboveground pools (Dugan et al. 2020).

Alternative 4 includes a 15-fold increase in the level of prescribed burning and fires managed for resource benefits (compared to the reference period) of up to 17,760 acres annually. If maximum levels of prescribed burning are achieved, this would result in a potential loss of about 149,683 Mg of carbon annually (0.1497 Tg C), as estimated from the historical analysis (Dugan et al. 2020). However, the historical period included wildfires, which generally burn at higher severities and result in greater carbon losses than prescribed burns. By reducing hazardous fuels, additional prescribed burning up to the maximum levels described in alternative 4 may indirectly reduce the risk of more severe wildfires and greater carbon losses in the future (Agee and Skinner 2005; Wiedinmyer and Hurteau 2010).

Considering the maximum area treated with harvesting and prescribed fire, the amount of carbon that might be removed is small relative to the approximately 56.9 million metric tonnes (Tg) of carbon stored in the forest ecosystem of Carson NF. With maximum intensification, potential management actions would affect up to 1.25 percent of the forested area and about 0.1585 Tg of carbon annually. The alternative 4 actions would not significantly, adversely, or permanently affect forest carbon storage, but would rather achieve a more resilient forest condition that would improve the ability of the Carson NF to maintain carbon stocks and enhance carbon uptake (Dugan et al. 2020).

The total annual lost carbon storage potential would be slightly greater than under alternative 2, though still small compared to the total carbon stocks on the forest and within the uncertainty for measurement of total forest carbon stocks (figure 19). Lost storage potential is likely to be offset by an increased rate of carbon accumulation due to younger forest establishment following disturbance.

Federally Recognized Tribes

Description of Affected Environment

The Carson shares a common boundary with the Jicarilla Apache Nation, Picuris Pueblo, Southern Ute Mountain Tribe, and Taos Pueblo, and is in proximity to several other tribal communities.

The government-to-government relationship between the Forest Service and federally recognized tribes is distinct from that of other interests and constituencies under a variety of Federal authorities. These authorities direct the agency to administer forest management activities and uses in a manner that is sensitive to traditional American Indian beliefs and cultural practices. The 2008 Farm Bill (Forestry Title VIII, Subtitle B (Sections 8101-8107), as well as related authorities, is perhaps the single most important piece of legislation providing for Native American access to NFS lands and forest products. The 2008 Farm Bill is integral in our relationship with federally recognized tribes.

The Forest Service manages a great diversity of landscapes and sites that are culturally important sites and held sacred by federally recognized tribes. Specific locations on the forest are often held in confidence to protect these important values.

Legal responsibilities are maintained through consultation and engagement between federally recognized tribes and the Forest Service. The Carson regularly consults with federally recognized tribes and pueblos that have aboriginal territories within and traditional ties to the land now administered by the forest.

Environmental Consequences for Federally Recognized Tribes

Methodology and Analysis

Probable management activities related to alternatives are used to evaluate or predict short- and/or long-term effects to federally recognized tribes on the Carson. These management activities are evaluated in relation to their effects on the uniqueness and values of the people and tribal culture and the role the forest and forest management plays in supporting the cultural, social, religious, and economic needs of federally recognized tribes:

- Federally recognized tribes desired conditions related to recognizing local communities and their history.
- Federally recognized tribes desired conditions ensure forest resources are available to contribute to the cultural, social, religious way of life and economic opportunity.
- Federally recognized tribes' guidelines for traditional use.
- Average acres of ponderosa pine forest and mixed conifer with frequent fire that could potentially be treated with fire (prescribed or managed) or by mechanical means (timber harvesting and thinning) using the objectives identified for ponderosa pine forest and mixed conifer with frequent fire for each alternative.
- Plan components related to recreation.
- The amount and location of recommended wilderness management areas.

Assumptions

Federally recognized tribes are not expected to be a primary driver in selecting one alternative over another, because predicted impacts between alternatives with regard to federally recognized tribes are not dramatically different. Differences between alternatives are small because:

- All alternatives are expected to achieve desired conditions for federally recognized tribes in the proposed plan.
- All projects implemented on the forest would require a site-specific analysis of their potential impacts to federally recognized tribes and the ability to access traditional uses important to their culture.
- None of the alternatives has specific objectives to contribute to the social, cultural, religious, and economic opportunity during the life of the plan. Proposals would be considered through project-level

planning. The environmental consequences of ensuring access and availability to areas important for traditional uses are identified and analyzed at the project level.

- None of the alternatives prohibit future site-specific project planning that contribute to the social, cultural, and economic opportunity.

Environmental Consequences for Federally Recognized Tribes – Alternative 1

There is specific language in all but alternative 1 for the Carson to work and collaborate with tribes and pueblos to ensure sacred sites and traditional cultural properties are not adversely affected by Carson proposed actions. Alternative 1 would not explicitly recognize the value of the forest to federally recognized tribes and the importance of management of forest resources to contribute to social, cultural, and economic opportunity. Forest management that does not recognize and value the significance of forest lands and resources to the culture and social fabric of federally recognized tribes may contribute to the loss of the culture.

The current plan allows for the use of mechanical treatment and prescribed fire as a management tool. There are no set objectives within the plan, but the forest has completed about 94,300 acres over a 10-year period in ponderosa pine forest and 42,800 acres in mixed conifer with frequent fire. Both prescribed fire and mechanical treatments can have negative effects on tribal spiritual and cultural sites through alteration or destruction from disturbance by vehicle, personnel, or equipment. These may be in the form of erosion, deflation, and/or degradation of sediments or soils due to vegetation removal or other activities. Mechanical treatment tends to have a greater impact as a result of road construction and vegetation clearing that create more opportunity for public intrusion. Prescribed fire treatment when executed well would have minimal risks to cultural and sacred sites, mostly related to degradation during burning and erosion afterward. This alternative allows for recreation projects to take place, but it does not have any objectives for new trails, campground improvements, or other experiences. Improved recreation opportunity and experiences could result in increased visitation. Increased public visitation could result in more people accidentally intruding upon important cultural or sacred sites.

The current plan does not have any areas proposed as recommended wilderness. Wilderness areas can provide some protection for cultural and sacred sites from public intrusion and/or future project activities. Some tribes have expressed concerns regarding wilderness areas adjacent to their tribal lands because they would limit the opportunity for vegetation treatment to reduce the risk of uncharacteristic wildfire that could harm important watersheds or their tribal lands. For some tribes, wilderness areas could limit access for tribal elders to cultural or sacred sites who may not be able to easily walk to sites.

Environmental Consequences for Federally Recognized Tribes – Alternatives 2, 3, 4 and 5

Alternatives 2, 3, 4 and 5 specifically identify the unique government-to-government relationship that federally recognized tribes and the U.S. Government share. These alternatives provide direction for the Carson to consult, collaborate, and seek input from federally recognized tribes in order to ensure sacred sites, traditional cultural properties, or other resources that federally recognized tribes hold as sacred or important to tribal identity or values are not adversely affected by any management related activities. If sacred sites, traditional cultural properties, or other resources that federally recognized tribes hold as sacred or important to tribal identity or values are located within any proposed project area, then the Carson is obligated to take these into consideration and make every effort to avoid impacts to these kinds of sites.

Consulting with federally recognized tribes early and often is the best and most effective way to gather information related to potential sacred sites, traditional cultural properties, or other resources that federally recognized tribes hold as sacred or important to tribal identity or values.

Through tribal consultation, projects and management activities should be planned and administered to prevent or minimize impacts to places that federally recognized tribes view as sacred or as a traditional cultural property.

Alternatives 2, 3, 4, and 5 have a combination of objectives for vegetation treatment that use mechanical means and prescribed fire in ponderosa pine forest and mixed conifer with frequent fire over a 10-year period. Alternatives 2 and 5 mechanically treat 27,500 to 60,000 acres of both ponderosa pine forest and mixed conifer with frequent fire and use prescribed fire to treat 100,000 to 165,000 acres. Alternative 3 increases mechanical treatment, treating 65,000 to 130,000 acres and alternative 4 uses mostly prescribed fire, treating 125,000 to 225,000 acres. Alternative 2 provides the best balance for treatment and potentially causes less impact from mechanical treatment than alternative 1 and 3. Those impacts may include alteration or destruction of tribal heritage resources from disturbance by vehicle, personnel, or equipment or erosion, deflation, and/or degradation of sediments or soils due to vegetation removal or other activities. Alteration by mechanical treatments can also detract from intact landscapes of tribal significance alternative 4 would result in the least impact from mechanical treatments.

All the alternatives have recreation desired conditions and objectives to improve upon and potentially increase recreation opportunities and experiences, but also has plan language that states new recreation opportunities must be compatible with existing cultural resources. The alternative potentially could increase visitation on the forest, but appropriate management should limit increased negative effects to tribal cultural and sacred sites such as alteration of shrines or collection from clay sites. Alternative 3 would allow more recreation opportunity than the other alternatives so the chance of these types of negative impacts could be increased.

Alternative 2 has 9,189 acres of recommended wilderness, alternative 3 has no acreage proposed, alternative 4 has 45,473 acres, and alternative 5 has 67,996 acres. For tribes, wilderness could be seen as a balance of positive and negative impacts. Wilderness would maintain the landscape as is, without modification which is traditionally valued. On the other hand, it has the potential to limit some traditional uses such as fuelwood gathering. None of the recommended wilderness is adjacent to tribal lands or in a known critical watershed that could be impacted. In alternatives 4 and 5, more lands are set aside where any cultural and sacred sites would be less impacted by the general public but could create accessibility issues for elder tribal members. Alternative 2 potentially provides more protection than alternative 1 and 3, but access for elders would be more limited.

Cumulative Environmental Consequences for Federally Recognized Tribes

The tribes work with many Federal agencies (e.g., BLM, U.S. Fish and Wildlife, U.S. Corps of Engineers, U.S. Forest Service). It can be very challenging for tribes to coordinate efforts that provide maximum benefit. In northern New Mexico, State, local, and Federal entities have learned that through collaboration they can accomplish more in the region and better serve the needs of local communities. Tribes have recently been participating more in regional planning projects which can affect their tribal lands and people. This effort can improve and protect the health of the lands and resources important to tribes.

Negative effects such as the loss or degradation of sacred sites, traditional cultural properties, and/or other resources that federally recognized tribes hold as sacred or important to tribal identity or values has happened in the past and probably will happen in the future on Carson lands and lands managed by other entities. As time progresses, this loss results in fewer resources available to future tribal generations to learn about and connect with their cultural/religious/spiritual practices, values, and identities. The design criteria, mitigation, and monitoring measures related to cultural resources for any potential project on public land serve to protect them and avoid potential negative effects to cultural resources deemed to be significant (i.e., historic properties).

Rural Historic Communities

Description of Affected Environment

Since its inception in the early 1900s as the Taos Forest Reserve, the Carson NF has been an important source for many of the essential requirements for settling this region of the southwestern frontier. These lands served Native American tribes, Spain, and Mexico long before they were managed by the United States or national forest borders were defined. The heritage, culture, traditions, and values that existed prior to the Carson's establishment were handed down over generations and still exist in northern New Mexico today. To this day, these traditional communities retain a strong connection to the land and rely on the Carson and its natural resources to sustain their cultural, spiritual, and economic way of life. Forest management needs to balance this traditional way of life, defined by cultural identity of traditional communities, and the changes brought about by increased development, tourism, and other contemporary uses. By virtue of this, the Carson has the challenge of serving multiple needs through present day management.

The Carson has a diverse community composition with time steeped heritage and tradition, where Native Americans, Hispanic, Anglo, and a minority of other cultures have combined to make northern New Mexico a multicultural center. These cultures have ties to the forest through attachments to the land that may be generations old or a new found discovery. In addition to serving the local population, the Carson also offers visitors who travel to the region a unique scenic, cultural, thrilling, and remote experience. The Carson and the surrounding lands are strongly influenced and shaped by local, time-honored traditions, cultural diversity, and by those from other areas around the country who wish to experience this unique setting.

Traditions

Residents of communities surrounding the Carson have a strong connection to the land and its resources. There is also a strong sense of community across the diversity that exists within the analysis area. Both sentiments date back centuries, before this part of the country became part of the United States. Local passions continue to demonstrate these time-honored connections to the land and culture, giving long-lasting vibrancy to deeply rooted traditions and ways of life. The Carson has been an integral part of this history and continues to play a prominent role in these traditions and uses of the planning area.

There is a strong sense of attachment to the land that is the Carson. Three major components characterize this sense of attachment. The first comes from traditional users having a sense of personal ownership, based on historical associations with NFS-managed lands. There is a significant generational element to this theme, which dates to the time before the Carson was designated. The second component is derived from historical practices around the use of natural resources. These traditional users have first-hand knowledge and self-interest in management of forest resources that result in a culturally based understanding, and attachment to, forest lands. The third component is a valuing of Carson NFS lands as a legacy. It is understood that this land was inherited and is a unique resource that should be cared for and passed down to future generations (USDA FS 2006).

Likewise, these historical connections to the land have been instrumental in giving the Carson a large part of its character. They still influence the forest in present-day terms, through various means, but especially through land grants, acequias, and traditional uses.

Land Grants

Land grant history within the analysis area has a significant bearing on social and cultural conditions as they relate to the Carson. Spain and Mexico issued land grants before the United States entered the

Southwest, and they have been the topic of deliberation and controversy since the Treaty of Guadalupe Hidalgo in 1848 (US GAO 2004).

From the late 17th century to the 19th century, Spain and Mexico issued three types of land grants or mercedes to promote development in the frontier lands that today constitute the American Southwest. The two most common types of Spanish and Mexican land grants-mercedes made in New Mexico were community land grants and individual land grants. Community land grants were typically organized around a central plaza, whereby each settler received an individual allotment for a household tract of land to farm, common land was set aside as part of the grant for use by the entire community. Individual land grants, as the name suggests, were made in the name of specific individuals.

When the United States took over ownership of much of the Southwest in 1848 through the Treaty of Guadalupe Hidalgo, it agreed to recognize property rights awarded under established land grants. Two successive confirmation processes were used by the U.S. Congress in the 1800s and 1900s, to determine whether to recognize and confirm or to reject land grants in New Mexico.

Many issues have arisen over the confirmation of land grants. The legitimacy of the processes used and of those who implemented it have been questioned. Concerns over confirmed boundaries and the fairness and equity of the processes remain.

In total, over 17.9 million acres in New Mexico were claimed as land grants with 9.9 million acres (55 percent) confirmed and awarded by Congress. Currently, however, only 6 percent of the community land grant acres remain in land grant status. The remaining 94 percent was lost over time during the confirmation process, to attorney's fees, and to partitioning suits, taxes, foreclosure, and real estate transactions, which occurred after the two successive confirmation processes. The Carson has since been put into stewardship over some of the lands in question. This has led to resentment over property some believe was wrongfully taken.

Acequias

Acequias are the historic ditches that bring water from rivers and streams to communities for irrigation purposes. They are generally communally run through associations headed by the majordomo (ditch-master) and some date back to the time of Spanish settlement in the 1500s. These waterways are still used today for the original purposes for which they were established. They represent how important water is in the desert Southwest and were instrumental in settling the area. Those who use and maintain these ditches protect their historic values, as well as their utilitarian purposes. These values are also recognized by the State of New Mexico through the New Mexico Acequia Commission.

Acequias are vital institutions in New Mexico, and their origins date back to the Moors of North Africa, who introduced this type of water conveyance system to Spain. Spanish settlers brought this tradition to New Mexico in 1598, inspired in part by techniques that Pueblo Indians developed. Acequias are considered political subdivisions of the state and are collaborated with as local governments. Acequias are vital in the production of crops and livestock, they are inherently special riparian areas for many species of wildlife and plants, and they provide spiritual and aesthetic value.

Acequias are an integral part of the cultural and traditional heritage identified in northern New Mexico. The Carson plays a role in this heritage by working with acequia commissions to support ongoing maintenance and accommodate access and needed infrastructure for historic ditches located on NFS lands.

Acequias that predate the national forest are afforded special rights and status under NFS management. Under the Chief's Policy relating to the Act of July 26, 1866 (Revised Statute 2339), continuing routine operation and maintenance of acequias is allowed without special-use authorization being required. A special-use authorization is the legal instrument that allows acequias to perform activities other than

routine operation and maintenance on NFS lands. Acequia activities, such as construction or reconstruction, changes in the acequia alignment, or additional infrastructure outside the original footprint or established right-of-way, require special-use authorization.

The Carson NF administers approximately 36 acequia permits. There are additional acequias on the Carson, but they are not all identified in the database of the Office of the State Engineer.

Traditional Uses

Traditional uses as they relate to the Carson are uses with strong cultural ties to northern New Mexico's heritage. The national forest manages the natural resources and landscapes that sustain northern New Mexico traditional communities, cultures, and traditions, now and into the future. Local heritage, culture, traditions, and values have been handed down over generations and predate United States management of this area. Longstanding use of the forest and its natural resources are fundamental to the interconnected economic, social, and cultural vitality of many northern New Mexico inhabitants. These uses include but are not limited to, use of common waters, livestock grazing, hunting and fishing, medicinal herb gathering, firewood gathering, forest access, and wood gathering.

Environmental Consequences for Rural Historic Communities

Methodology and Analysis

Probable management activities by alternative are used to evaluate or predict effects to rural historic communities on the Carson. These management activities are evaluated in relation to their effects on the uniqueness and values of the people and culture and the role the forest plays in supporting the cultural, social, and economic needs of rural historic communities:

- Rural historic communities desired conditions related to recognizing local communities and their history.
- Rural historic communities desired conditions that ensure forest resources are available to contribute to the cultural, social way of life and economic opportunity.
- Rural historic communities' guidelines for traditional use.
- The amount and location of recommended wilderness management areas.

Assumptions

Rural historic communities are not expected to be a primary driver in selecting one alternative over another, because impacts with regard to rural historic communities are not dramatically different. Differences among alternatives are small because:

- All alternatives are expected to achieve desired conditions for rural historic communities in the proposed plan.
- All projects implemented on the forest would require a site-specific analysis of their potential impacts to rural historic communities and the ability to access traditional uses important to their culture.
- None of the alternatives has specific objectives to contribute to the social, cultural, and economic opportunity during the life of the plan. Proposals would be considered through project-level planning. The environmental consequences of ensuring access and availability to areas important for traditional uses are identified and analyzed at the project level.
- None of the alternatives prohibits future site-specific project planning that contributes to the social, cultural, and economic opportunity.

Environmental Consequences for Rural Historic Communities - Alternative 1

There is no specific resource section for the management of rural historic communities in the 1986 Forest Plan. There are some related goals, objectives, standards, and guidelines located throughout the plan in other resource sections. The plan has language to show respect to all citizens, work with people as partners, provide education to people, manage the forest sustainably to ensure it is available for future generations, provide people with access to use the forest, and make firewood and forest products available. This plan guidance is applicable to all local communities and visitors to the area. Many of the small communities and people who live either adjacent to or within the boundaries of the Carson have ties to this area lasting generations and have long relied upon the NFS lands for their social, cultural, and economic subsistence. While traditional uses would be available to rural historic communities under alternative 1, the plan would not recognize the value of the forest to these local communities and the importance of managing forest resources to contribute to social, cultural, and economic opportunity. Forest management that does not recognize and value the significance of the NFS lands and resources to the culture and social fabric may contribute to the loss or decline of the culture. Alternative 1 proposes no new recommended wilderness.

Environmental Consequences for Rural Historic Communities – All Action Alternatives

Action alternatives would identify rural historic communities as a resource and specifically recognize the uniqueness of the culture of the region and the importance of the contribution forest resources make to the culture and economy in local communities. There is language recognizing the history of nearby rural communities and the importance of traditional uses for sustaining livelihoods and the social fabric. The plan states that longstanding communities would have access to spiritual and cultural sites important to them and that the forest provides opportunities for local communities to benefit from forest products for subsistence and economic support. This recognition in the plan requires that this access and opportunity are part of project and long-range planning so that resources essential for cultural and traditional needs are available and sustainable, and thereby, contribute to the maintenance of local cultures and traditions.

There is plan language that emphasizes the importance of the forest and forest resources to the local rural communities. Plan language also recognizes the unique culture of the rural historic communities and the importance of connections to the land and contributions that Forest Service management can provide. By explicitly valuing people and communities in the plan, the Forest Service would develop improved working and personal relationships to better serve and support these communities. By explicitly recognizing and valuing local culture in the plan, the Carson would become a better community member and a better steward of the land. The plan would provide enhanced opportunities for using and benefiting from the forest, which could lead to improvements in economic opportunity and help sustain local communities.

New Mexico, specifically northern New Mexico, has little industry or other employment that offers high paying jobs or provides a high standard of living for all its residents. These communities have traditionally relied upon the forest and surrounding lands for their subsistence. Many feel they are not allowed to adequately use the forest as their ancestors did to support their social, cultural, and economic livelihood. Management direction states that the Carson needs to recognize the importance of forest resources to these communities and provide opportunity for access for firewood, cultural sites, recreation, hunting, livestock grazing, and other important activities and resources. Recognition of this dependence and management that accounts for it would help contribute to improved economic and cultural conditions in these communities.

Alternative 2 has 9,189 acres of recommended wilderness, which balances lands important for cultural and provisional ecosystem services with protecting primitive lands. While there would be some effect in terms of reduced easy access, the recommended areas are not generally easily accessible and any effect on traditional uses would be minimal. Alternative 3 has no recommended wilderness, which would result in

fewer limitations to access for traditional uses. Alternative 4 would recommend 45,473 acres as wilderness and alternative 5 would recommend 67,996 acres. Both alternatives would reduce some access for traditional uses important to rural historic communities. Alternative 5 would have a greater effect than alternative 4. While wilderness serves a valuable land preservation role, it is viewed by many in local communities as a way to take land away that their families have relied on for generations.

Cumulative Environmental Consequences for Rural Historic Communities

In northern New Mexico, many people and communities have ties to land grants that existed before the United States owned the land. There are other community members whose families have been here for generations though they may not be heirs to a land grant. Both have strong social and cultural ties to the land and the forest, which has become integral to their way of life, their culture, and their livelihood. Many of the lands that these communities have used and valued are now part of the Carson and Santa Fe National Forests, the BLM Rio Grande del Norte National Monument, tribal, State, county, and private lands.

In northern New Mexico, several government entities work closely with rural communities and have an influence on the social, cultural, and economic vibrancy of the area. County governments work to improve infrastructure, support agriculture, and work to provide new businesses and jobs. The Soil and Water Conservation Districts work closely with farmers, ranchers, and communities to improve land and water conditions and support the economy and livelihoods in the area. The New Mexico Land Grant Council and the New Mexico Acequia Commission support local rural communities, advocate for funding and support from the State, and work closely with other State and Federal agencies to help maintain the culture and economy in New Mexico. Many non-governmental organizations work closely with rural communities and families. The ability of these organizations, along with Federal land managers, to work together to help sustain the culture and economy of the region has grown over the last several years. As these organizations and other entities learn to work collaboratively to benefit local communities and the families who live here, the lives of northern New Mexicans should improve, and they should have better access to the forest and other resources important for sustaining their culture.

Since the late sixties and early seventies, northern New Mexico has changed as many people from other areas of the country emigrated to enjoy the sunshine, beautiful scenery, and recreation opportunities. Areas around the Carson have developed into popular recreation destinations that draw visitors from other areas of the country. At the same time, the area retains vibrant communities with strong ties to the land through agriculture, grazing, and forest product collection. Changing uses and values have created less reliance on forest resources and desires for increased land protection and restrictions on use. While population growth in the region has stagnated, long-term challenges for the rural historic communities, newcomers seeking new opportunity, and government entities will be to balance the need to sustain traditional practices and uses with the need to grow economies by bringing in new opportunities and businesses, while sustaining healthy ecosystems for the future.

Cultural Resources

Description of Affected Environment

The Carson has a rich record of cultural and historic resources that document almost continuous human presence for at least the past 13,000 years. There are numerous types of cultural resources on the Carson including, but certainly not limited to, pit houses, pueblitos, masonry structures, room blocks, lithic scatters, prehistoric camp sites, stone rings, rock alignments, stone tool quarries, trails, timber camps, Civilian Conservation Corps camps, cabins, animal kill sites, rock art, traditional cultural properties, and culturally modified trees. American Indians ancestral to the ethnic affiliations of the contemporary Pueblo, Athabascan, Ute, and Comanche people have inhabited or used forest resources over much of this

time. Europeans began to occupy the area over 400 years ago. Carson NFS lands have been under the management of the Forest Service since 1906.

Many cultural resources are also considered traditionally significant to the federally recognized tribes and pueblos associated with the Carson NF, with at least 6,636 recorded cultural resources within its boundaries. As of July 2016, only 15 percent (219,713 acres) of the forest had been surveyed. Sixty-four percent (4,320) of the cultural resources recorded on the forest are prehistoric sites, 22 percent (1,449) are historic period sites, and 10 percent (642) are multi-component sites. The remaining 5 percent (225) are unknown, with no temporally or spatially diagnostic artifacts present. All of the currently recorded or known sites (n=6,636), as well as any potential (but undiscovered) sites contained within the remaining 85 percent of the Carson that has not been inventoried for cultural resources comprise the potential affected environment for the purposes of this analysis.

The Carson has six sites listed on the National Register of Historic Places (Pueblito Canyon Ruin, Pueblito Canyon East, Cabresto Mesa Tower Complex, Victor Ortega Cabin, the Ring Place, and the Aldo Leopold House), with 2,588 more sites eligible for listing. In addition, 441 sites are not eligible for listing and 3,604 sites remain unevaluated. The Cumbres and Toltec Railroad National Historic Landmark enters a portion of the Carson and the Old Spanish National Historic Trail crosses the forest. The conditions of the cultural resources on the Carson are most notably impacted by water and wind erosion, livestock grazing, recreation, construction, vehicular traffic, and vandalism, which fortunately have not been severe in most cases. Numerous cultural sites on the forest are significant social and economic contributors to the geographic context, region, and nation. They provide opportunities for cultural tourism, education, and research. They are also necessary for maintaining the cultural identity of the traditional communities within and around the Carson.

Cultural resources are nonrenewable, with few exceptions. Once the resource is disturbed, damaged, moved, altered, or removed, nothing can recover the information that could have been gained through analysis, or replace the opportunity for individuals to understand and experience the site. Forest Service management activities, public use, and natural processes have impacted cultural resources. Damage from vandalism (e.g., looting) continues to be a management issue. Current forest management practices are aimed at minimizing and/or avoiding negative impacts to cultural resources. This is accomplished primarily through compliance with Section 106 of the National Historic Preservation Act.

Environmental Consequences for Cultural Resources

This section describes the effects of the proposed revised plan and alternatives on historic properties and cultural resources. Management of culture and history is an important part of Federal land management policy and practice.

Preservation of this resource helps to give a sense of orientation to the American people whose ancestors left behind traces of their legacy in archaeological sites, historic properties, traditional cultural places, and sacred sites, among others. It is this resource that ties together the historic human use of the landscape and practices used on it today. It tells the story of the changes in the environment and how humans benefited, impacted, or were otherwise affected by their use of the landscape and varying environmental conditions through time.

Methodology and Analysis

Probable management activities related to alternatives are used to evaluate or predict short- and/or long-term effects to cultural resources on the Carson. These management activities are evaluated in relation to their effects on the uniqueness and values of the people and culture and the role the forest plays in supporting the cultural, social, and economic needs of rural historic communities:

- Rural historic communities desired conditions related to recognizing local communities and their history.
- Transportation and access objectives related to roads and trails.
- Average acres of ponderosa pine forest and mixed conifer with frequent fire that would be treated with fire or by mechanical means based on the objectives identified for ponderosa pine forest and mixed conifer with frequent fire for each alternative.

Assumptions

Cultural resources are not expected to be a primary driver in selecting one alternative over another, because predicted impacts between alternatives regarding cultural resources are not dramatically different. Differences between alternatives are small because:

- All alternatives are expected to achieve desired conditions for cultural resources in the plan.
- All projects implemented on the forest would require a site-specific analysis of their potential impacts to cultural resources and the ability to access traditional uses important to their culture.
- None of the alternatives has specific objectives to contribute to the preservation and protection of cultural resources during the life of the plan. Proposals would be considered through project-level planning. Environmental consequences of ensuring access and availability to areas' important cultural resources are identified and analyzed at the project level.
- None of the alternatives prohibits future site-specific project planning that contributes to the preservation and protection of cultural resources.

Environmental Consequences for Cultural Resources Common to All Alternatives

At a plan level, the environmental consequences associated with all the alternatives are similar in regards to potential effects to cultural resources (with a couple of notable exceptions) because the alternatives are broad in scope and do not imply specific project-level impacts. There are wide variations in some categories within the range of alternatives; however, in most cases the net potential for adverse effects to cultural resources is expected to be similar because all known (and unknown) sites within any given treatment area (regardless of the type of treatment or project) would have the potential to be directly affected and/or indirectly affected in similar ways by project activities. For example, if there is more prescribed burning and less mechanical treatment in one alternative, and vice versa in another, they would have the same basic potential effects to cultural resources because all sites within the entire prescribed burn and mechanical treatment areas could potentially be directly damaged or destroyed by vehicles, personnel, or other equipment associated with either kind of activity. Cultural resources could also potentially be damaged or destroyed by direct implementation activities such as burning from fire or disturbance associated with timber felling, decking, and skidding. Additionally, indirect effects in the form of resultant erosion and deflation from vegetation loss or other ground disturbance associated with either prescribed burning or timber harvesting activities has the potential to adversely affect cultural resources.

Mechanical treatments impact cultural resources by compacting the ground in and around archaeological sites and by disturbing the distribution or arrangement of artifacts within the site. Machinery used to conduct mechanical treatments may also alter the physical properties of artifacts. These factors challenge archeological understanding of these areas and degrade qualities that make the sites eligible for inclusion on the national register.

The cultural resources on the Carson have persisted through many fire cycles over time and are generally not highly damaged by low-severity fire that moves quickly across the landscape. Lower-severity fires

can damage cultural resources by altering their chemical or physical properties, such as charring exterior surfaces or promoting faster decomposition rates. In some cases, lower-severity fires can completely consume plant fibers, hair, or textiles, ruining the important historical data they once held.

High-severity fire can be devastating to cultural resources, especially for perishable and fire-sensitive items such as wood, material, basketry, hides, leather, and plant residues or seeds. The extreme temperatures destroy or alter the physical characters of artifacts, which significantly alters informational context. These fires also affect the potential for dating features in a historical context by either altering their physical composition as in the realignment of radiometric iron in hearths or the deposition of recent carbon in archaeological contexts with the potential for C14 dating. Furthermore, severe fire damages vegetation and ground cover, often leading to soil hydrophobicity, thereby increasing erosion and water run-off, which can move cultural materials from their origin. Finally, management actions associated with wildfire suppression frequently lead to effects to cultural resources including the construction of fire line through sites, burning of perishable materials resulting from suppression ignition and other effects associated with the suppression of wildfire.

All future proposed actions that come from plan direction that have the potential to effect cultural resources would be subject to compliance with Section 106 of the National Historic Preservation Act, which always consists of a cultural resource inventory of some kind and then appropriate avoidance and/or mitigation measures. Different mitigation and avoidance measures would be used for different treatment activities, but the potential adverse effects to cultural resources would essentially be equivalent (direct damage and destruction by personnel, vehicles or equipment; or indirect erosion, deflation or site contextual degradation). Generally, the amount and degree of these kinds of impacts would not vary by alternative because management of cultural resources is almost exclusively dictated by law, regulation, and policy.

Given that the various tradeoffs among the different alternatives result in approximately the same number of net acres to be included in potential future project areas, and the plan is addressing effects at a very broad level, the environmental consequences would be similar with a couple of notable exceptions (see below).

Environmental Consequences for Cultural Resources – Alternative 1

Environmental consequences associated with alternative 1 would be unique in regards to the potential effects to cultural resources from unplanned catastrophic wildfire. This is because alternative 1 proposes significantly less overall timber and fuels treatment (landscape restoration) than any other alternative, which would result in higher rates of unnatural fuel loading on the landscape. In the event of an unplanned catastrophic wildfire the fire intensity would be much higher and fire behavior would be more erratic and unpredictable. Cultural resources that have been burned over (with minimal or no damage) for hundreds or perhaps thousands of years as a part of the natural fire ecology, would have a high potential to be damaged or destroyed by a very high-intensity fire event.

Environmental Consequences for Cultural Resources – Alternatives 2, 3, 4, and 5

Environmental consequences associated with alternatives 2, 3, 4, and 5 would be unique in regard to potential effects to cultural resources from transportation and access. This is because alternatives 2, 3, 4, and 5 have very different amounts (proposed miles) of proposed road grading or culvert cleaning and road obliteration or naturalization. Road maintenance, construction, and obliteration have a relatively high potential to affect cultural resources because the Carson has many cultural resources recorded within, adjacent to, or near forest roads. A large number of sites are recorded in these locations because, in general, travel corridors have been travel corridors for long periods of time. They are usually situated in the most traversable locations on the landscape; therefore, it is very common for forest roads to follow historic or pioneer roads, which followed old Native American trails or routes, which followed game

trails. In many cases, forest road routes have been routes on the landscape for hundreds, if not thousands of years.

Although legal requirements for compliance would be responsible for ensuring effects to cultural resources are minimized, the potential exists for cultural resources and archaeology to be affected by indirect effects associated with machinery moving across the landscape that would degrade undiscovered cultural sites and compact the soil. Damage caused by vehicles can include reduction of cultural deposits, displacement and damage to artifacts, and loss of soils and vegetation. Increased road access into the forest could also increase visitation to newly opened areas and have greater adverse impacts on cultural resources.

The different amounts of proposed road grading or culvert cleaning and road decommissioning would translate into different potential effects to cultural resources because road grading, culvert cleaning, and road obliteration or naturalization have a relatively high potential to affect cultural resources for the reasons stated above. Alternative 4 would have less potential to affect cultural resources than alternatives 2, 3, and 5, because there are fewer proposed miles of road work (i.e., objectives for 40 miles of road obliteration or naturalization and 0 miles of road grading or culvert cleaning). Alternatives 2 and 5 would have less potential to affect cultural resources than alternative 3, but more than alternative 4. Alternative 3 has the greatest potential to affect cultural resources.

Cumulative Environmental Consequences for Cultural Resources

The landscape surrounding the Carson is managed by multiple entities including other national forests, the Bureau of Land Management, Tribes, the State, local governments, and private landowners. When projects are funded with Federal money, they must follow the requirements of the National Historic Preservation Act. Federal money may fund projects on Federal land, on tribal lands through the Bureau of Indian Affairs, or on State, county, or private land through grants. In all these situations, the National Historic Preservation Act protects, interprets, and minimizes impacts to cultural resources and maintains information that has the potential to provide new or significant data related to a specific archeological culture, time period, or artifact type. Activities that occur on private land or under local jurisdictions that are funded by non-Federal money may not follow such strict guidelines and may therefore, cause the loss or dislocation of cultural resources.

Loss of archaeological resources has happened in the past and would continue to happen in the future. As time progresses, this loss results in fewer archaeological resources available to future generations to learn about past human lifeways, to study changes in human behavior through time, and to interpret the past for the public. On Federal lands, and projects funded with Federal money, the loss would be limited to cultural resources not meeting qualifying criteria as sites (i.e., isolated finds), or the effect would be considered to not affect those characteristics of a site that make it important, or the potential for effect would be considered very low. In other situations, impacts may be more detrimental to the archeological record and cultural interpretation. In surveyed areas, recording and archiving basic information about each cultural resource for future reference serves to partially mitigate any potential effects to cultural resources. Also, the design criteria, mitigation, and monitoring measures related to cultural resources for any potential federally funded project serves to protect them and avoid potential negative effects to cultural resources deemed to be significant (i.e., historic properties).

Sustainable Rangelands and Livestock Grazing

Livestock grazing on NFS land is a valuable resource to livestock owners. It has been a legitimate use of public lands since the inception of the NFS and has become an important part of the culture of the rural West, especially within northern New Mexico. "Owing to the history of land use and ownership in the region, many contemporary ranchers rely to a considerable degree on public land to graze their animals."

(Raish and McSweeney 2003). The objectives for Forest Service management of rangelands include managing range vegetation to provide ecosystem diversity and ecosystem and environmental quality while maintaining relationships with livestock owners, meeting the public's needs for rangeland uses, providing for livestock forage, maintaining wildlife food and habitat, and providing opportunities for economic diversity.

Rangeland management is an essential part of the Forest Service's multiple-use strategy to manage its lands. This strategy ensures that rangelands provide essential ecosystem services such as wildlife habitat and related recreation opportunities, watershed functions and livestock forage. The Forest Service has primarily managed rangelands for livestock forage (USDA FS 2015c).

Forage is a provisionary service in that it is a tangible product from an ecosystem that humans use for nutrition, materials, or energy. Being a tangible product, forage is managed by the Forest Service to be sustainable by ensuring that it will be available for future generations while still providing the other rangeland's ecosystem services required by their multiple-use strategy. To accomplish this, the Forest Service divides rangelands into allotments and monitors each one to maintain the overall rangeland health.

Description of Affected Environment

Current Grazing on the Carson and Within the Broader Landscape

Permitted Livestock Numbers

As of November 2014, the Carson permits 94,381 head months of cattle and sheep on the six ranger districts. There are 195 permits, with 167 permits for cow/calf pairs, 20 for bulls, and 8 for ewe/lamb pairs. A number of these permits are issued to grazing associations with multiple members. A grazing association is a group of several members who share the use of an allotment under one grazing permit. The Carson administers 16 association allotments. Associations are self-governed and determine how many head of livestock each member can graze within the authorized or permitted number for the allotment. The Forest Service officially recognizes the association as the sole permittee and often deals directly with association officers for annual authorization, billing, and operating instructions. In addition, the Carson administers 24 community allotments. These are allotments with multiple permittees, each with his/her individual permit for a set number of head. These community allotments typically have an association bull permit, as well. The Carson administers 21 allotments with only one permit holder. Bulls are counted along with the cow/calf numbers for allotments where no bull permit exists.

There are over 300 actual permitted users who could operate on the Carson. Currently there are 179 permits issued to individuals and 16 issued to grazing associations.

Grazing permittees on NFS lands are assessed an annual bill for collection for all livestock they graze in a year. This is assessed by animal pair over a specific period of time as expressed in head months. A multitude of indices dictate the grazing fee on an annual basis. For example, in 2015, the grazing fee for cattle was \$1.69/HM and for sheep it was \$0.34/HM; prior to 2015, the grazing fee for cattle was \$1.35/HM and for sheep it was \$0.27/HM.

Table 48 shows the current numbers of livestock permitted on the Carson, while table 49 shows the livestock permitted head months from 2004 to 2014. The head months are derived from the permitted number and grazing season dates.

Table 48. Permitted livestock on the Carson National Forest

Location	Cow/Calf	Bulls	Sheep	Total head months
Canjilon Ranger District	2,533	75	900	16,830
El Rito Ranger District	2,388	75	1,079	17,543
Jicarilla Ranger District	731	0	0	3,842
Camino Real Ranger District	1,483	62	0	6,194
Tres Piedras Ranger District	7,689	62	5,658	43,608
Questa Ranger District	1,619	0	0	6,364
Carson National Forest	16,443	274	7,637	94,381

Since 2004 on the Carson, permitted cattle head months have slightly increased and permitted sheep head months have decreased by over 50 percent (table 49). Sheep permits have declined over time and are currently only issued on the Canjilon, El Rito, and Tres Piedras Ranger Districts (table 49). Several factors are contributing to the decline in sheep numbers on the Carson: (1) permittees have elected to convert from sheep to cattle operations using a 5 to 1 ratio, due to market conditions favoring cattle production over sheep (The National Academies 2007); (2) domestic sheep are no longer allowed to graze the fragile alpine tundra; and (3) disease carried by domestic sheep can threaten wild bighorn sheep populations (Besser et al. 2017; Besser et al. 2012).

For each allotment, numbers and classes of permitted livestock along with grazing season dates are evaluated in a NEPA analysis; typically, an environmental assessment. Management is occasionally adjusted through this process, depending on range condition, management considerations, infrastructure improvements, and other multiple use considerations. Northern New Mexico has experienced persistent drought conditions during the last 15 years. In the last several years, the drought has impacted range conditions and resulted in livestock numbers (particularly authorized) to be adjusted downward.

Table 49. Permitted and authorized livestock (head months) from 2004 to 2014 on the Carson NF

Year	Permitted Cattle	Authorized Cattle	Permitted Sheep	Authorized Sheep
2004	77,667	66,422	31,091	20,945
2005	77,761	65,708	31,091	18,664
2006	77,761	68,321	31,091	15,154
2007	77,761	65,716	31,091	16,303
2008	77,761	68,406	28,811	15,279
2009	78,254	64,740	21,207	14,785
2010	77,910	69,910	21,207	8,332
2011	77,637	71,849	18,698	8,519
2012	77,818	69,352	18,698	14,161
2013	77,818	59,625	16,568	7,890
2014	77,818	57,571	16,568	8,463

Data from USDA Forest Service 2014. Natural Resource Manager (NRM), Washington, DC.

Annually Authorized Livestock Use

Within permitted numbers, the permittees request annually for the number of animals they choose to graze on the national forest, and negotiate that number with the Forest Service at annual operating meetings. It is the policy of the Carson to hold annual meetings early in the winter, so the permittees can

make other arrangements for any extra animals they own that may not be authorized to graze on the allotment the following spring.

The annually-authorized number of livestock and the grazing season dates are set in the annual operation instructions. From 2004 to 2014, authorized numbers have averaged 85 percent of the current permitted cattle numbers, and 56 percent of the current permitted sheep numbers, due to drought conditions or permittee voluntary preference

Grazing Activity within the Broader Landscape

In 2014, over 300 individuals and/or families had grazing operations on the Carson. The 2012 Census of Agriculture shows there are 2,570 beef farms and 410 sheep farms in the surrounding counties of northern New Mexico and southern Colorado.

As of 2014, the Carson had 195 permits for 16,443 cow/calf pairs and 7,637 ewe/lamb pairs (USDA FS 2014d). In 2012, the surrounding counties reported over 90,000 cow/calf pairs and 14,000 ewe/lamb pairs (USDA Census of Agriculture 2014a, 2014b). It is estimated that as many as 18 percent of the cattle and 55 percent of the sheep in the surrounding counties graze on the Carson for a portion of the year.

Wildlife and Wild Horses

Since 1986, elk numbers have increased on the Carson by around 40 percent. Elk compete for forage with cattle and other ungulates. Mule deer, prairie dogs, grasshoppers, and other herbivores rely on the forage base as well. It is the Carson's policy to strive for light to conservative livestock grazing intensity, in order to provide forage to and balance use with these other grazers and to stabilize and improve ecological conditions and sustainability. Other grazers also use areas on slopes greater than 40 percent, where cattle typically do not graze. This helps limit competition for forage preferred by permitted cattle.

In addition to wildlife, wild horses occupy two wild horse territories, which were congressionally designated after the passage of the 1971 Wild Free Roaming Horses and Burros Act. The 75,986-acre Jicarilla Wild Horse Territory on the Jicarilla Ranger District has an appropriate management level of 50 to 105 horses (2004 decision). Just to the west on public lands, the Bureau of Land Management has the 8,019-acre Carracas Mesa Herd Area. The appropriate management level for this herd area is 23 horses. Currently, the Jicarilla Wild Horse Territory and the Carracas Mesa Herd Area are managed jointly and have an appropriate management level of 73 to 128 horses. In April 2015, the population for the Jicarilla Joint Management Area was estimated to be between 342 and 502 horses. The 23,882-acre Jarita Mesa Wild Horse Territory and 31,010-acre herd use area (54,889 acres total) on the El Rito Ranger District has an appropriate management level of 20 to 70 horses (2002 decision). In December 2014, the population for the Jarita Mesa Wild Horse Territory was estimated to be 163 horses.

Range Condition

Range condition can be described as the "state of health" of the range. More specifically, range condition is an ecological measure of the current condition of the range as compared to the potential (often called "climax"). Plant species composition is the criteria used to make this determination (McGinty and White 2015). Range condition is evaluated for each allotment on the Carson.

As range condition improves, the variety of plant species growing on a specific allotment, or a pasture within an allotment, generally increases. Greater species diversity improves both the stability of the plant community over time and the quantity and quality of forage available to the grazing animal. Overall, plant production and stability of an allotment generally improves as range condition improves, because shallow-rooted plants (annuals or sod-forming perennials) are replaced by deeper-rooted, perennial, bunch grasses. Associated with this species shift are better overall soil hydrologic conditions. Rainfall infiltration rates increase while evaporation and soil erosion decrease. These factors, coupled with more

efficient use of water within the soil profile by deeper-rooted plants, result in greater forage production and stability. (Finch 2004)

In describing how range condition relates to production of livestock, McGinty and White (2015) state, “Higher range condition classes are generally associated with improved livestock production.” They go on to say, “Livestock are selective grazers. At higher condition classes, grazing animals can select from a greater diversity of plant species, thus maintaining a more optimum plane of nutrition. Diet quality levels will also vary less from season to season and year to year as compared to lower range condition classes.”

Current Range Conditions

After centuries of grazing, parts of the Carson are in good to excellent range condition and others are in poor or fair condition. Although the indications of historic overgrazing cannot be reversed simply by performing assessments or removing livestock, new science and intensive management have led to improved range condition in some areas, a stabilized trend in others, and the identification of areas in poor condition. Monitoring data continues to accumulate, and the prospects are good for adaptive management to lead to further improvement.

Range condition on the Carson has been improving since the 1950s, when the first long-term monitoring transects were established. Since 1995, all the grazing allotments on the Carson have undergone analysis through NEPA (environmental assessments), with new decisions regarding permitted numbers, season of use, and grazing management.

In those environmental assessments, each allotment was evaluated on a case-by-case basis, applying best available scientific information and the latest range management practices. Considerations for each allotment included probable forage production, current range condition and trend, carrying capacity, livestock distribution issues, and range improvement possibilities. There has also been a heavy emphasis on adaptive management options to give flexibility to producers and managers alike.

The Carson’s current plan (USDA FS Carson NF 1986, p. C. Forestwide Prescriptions Range-3) directs management to, “Strive to attain good to excellent range condition.” Overall, Carson allotments are in fair to good range condition and the trend is generally stable or improving; however, many forest ecosystems that are used for livestock grazing are currently departed from reference condition due to historic use and management actions. Forest openings are reduced in size and abundance, which has reduced the quantity of available grasses that are necessary to provide sustainable forage for livestock and wildlife grazing. Ponderosa ecosystems have become denser and more even-aged, increasing the threat of stand-replacing fire. Encroachment and infill by woody species, forage competition by other species, and reduced soil stability all contribute to the reduction in the availability of grass cover. Recent drought has contributed to the decrease in quality and quantity of available forage. Installation of water tanks for livestock and wildlife use disperses impacts and minimizes grazing pressure on riparian areas but may concentrate grazing, leading to adjacent soil and vegetation impacts.

Range Infrastructure

The Carson’s range infrastructure includes fencing, water developments, cattleguards, and corrals. There are thousands of miles of range fencing on the forest. Most of the fencing is very old and in poor to fair condition. The forest typically provides fencing materials, but permittees are required to provide the maintenance of fences for their allotments. Materials for maintenance and improvement to fencing and other range infrastructure are funded through permit fees, about \$30,000 per year. Cattleguards on the forest are structurally in good shape but require cleaning due to sediment build up. This work is completed by the Forest Service road maintenance crew.

Water developments include stock tanks, trick tanks, water wells, windmills, and pipelines. Recent drought conditions have shown a need for additional water developments in numerous locations on the

forest. Many existing water developments require maintenance or cleaning. New water developments can cost \$15,000 or more. New water developments, or repairs to existing water developments, are the responsibility of permittees. Most permittees cannot afford the necessary cost and ask for assistance from the Forest Service, which has limited funding available. Some permittees have sought grants or other funding. In several locations on the forest new water developments are being installed outside of riparian areas, to draw livestock away from these sensitive areas.

Climate change is expected to intensify drought conditions in the future. The need for new water developments or improvements to existing ones will become more important for livestock and wildlife species. Greater emphasis placed on watershed restoration would influence the need for new developments to be located away from water resources. Maintenance of existing fencing would continue to be required to keep livestock on appropriate pastures and allotments. A continuing issue between the Forest Service and adjacent landowners is the encroachment of livestock grazing onto private land from Forest Service allotments. Since New Mexico is a “fence-out” state, adjacent landowners are required to fence livestock out of their private lands from adjacent lands, including NFS lands.

Environmental Consequences for Sustainable Rangelands and Livestock Grazing

Methodology and Analysis

Probable management activities related to alternatives 1, 2, 3, 4, and 5 are used to evaluate or predict short- and/or long-term effects to sustainable rangelands and livestock grazing on the Carson. These management activities are evaluated in relation to their effects on range condition, available forage, and sustainable livestock grazing opportunities. To make broad comparisons between alternatives, this programmatic analysis uses:

- The amount and location of recommended wilderness management areas. The predicted impacts on range condition and sustainable livestock grazing opportunity would vary, depending on how much recommended wilderness is proposed in an alternative.
- Average acres of ponderosa pine forest and mixed conifer with frequent fire that would be treated with fire or by mechanical means based on the objectives identified for ponderosa pine forest and mixed conifer with frequent fire for each alternative.
- Recreation objectives related to campsites and mountain bike trails.
- Transportation and access objectives related to roads and trails.
- Riparian management zone objectives related to restoration.
- Seeps and springs standard related to development of new springs.
- Plan components to prevent disease transmission between permitted domestic sheep and bighorn sheep.
- Plan components related to recreation for the proposed San Antonio (alternatives 2 and 4), Valle Vidal (alternatives 2 and 4), Off-Highway (alternative 3), Rio Grande Cutthroat Trout (alternative 4), and Wetland Jewels (alternative 4) Management Areas.

Assumptions

Rangelands and livestock grazing are not expected to be a primary driver in selecting one alternative over another, because predicted impacts between alternatives regarding rangelands and livestock are not dramatically different. Differences between alternatives are small because:

- All alternatives are expected to achieve desired conditions for sustainable rangelands and livestock grazing in the proposed plan.
- Livestock that use rangelands can remove plant material, trample soils, and alter water flow patterns. However, with proper management, these impacts are insignificant in comparison to the natural resilience of ecosystems (Holling 1973). Therefore, for the purpose of this analysis, livestock grazing is not considered a surface-disturbing activity.
- Livestock grazing will be managed to meet specific standards and guidelines for rangeland health, including riparian standards and guidelines. In addition, range improvements will be used to meet standards and guidelines for rangeland health and to achieve rangeland management goals.
- Mitigations for impacts to, or from, livestock for any resource will be addressed in a site-specific analysis.
- Grazing use is managed similarly under all alternatives.
- All projects implemented on the forest would require a site-specific analysis of their potential impacts to rangeland and livestock grazing resources and verification of the need for mitigation to limit impacts to other resources.
- The amount of available forage is primarily dependent on vegetation restoration management activities, which under appropriate climate conditions should increase available forage for livestock and other ungulates.
- Livestock grazing use across all alternatives is anticipated and assumed to remain at constant levels or moderately increase with appropriate management. Drought is the one condition which can affect the condition of rangelands and ultimately affect livestock numbers, regardless of best management practices.
- None of the alternatives prohibit rangeland improvement and/or livestock grazing activities or project planning.

Environmental Consequences for Sustainable Rangelands and Livestock Grazing Common to All Alternatives

All of the alternatives use both mechanical treatment and prescribed fire for restoration of fire-dependent ecosystems. Alternative 1 identifies prescribed fire only in ponderosa pine (ponderosa pine forest) and not dry mixed conifer (mixed conifer with frequent fire). Alternatives 2, 3, 4, and 5 use prescribed fire in both of these vegetation communities. Mechanical treatment and prescribed fire both provide benefits by improving and promoting grasses and forbs, which increases availability of forage for livestock and other ungulates. The effects to livestock grazing and rangelands will be discussed below and the degree to which they occur is discussed under each alternative.

Mechanical treatment in ponderosa pine forest and mixed conifer with frequent fire opens up forest canopies and reduces tree density, which promotes the growth of grasses, forbs, and shrubs in ponderosa pine forest and grasses, forbs, and oak in mixed conifer with frequent fire. Both would increase the availability of forage for livestock and other ungulates. Short-term impacts to livestock grazing are minimal, as thinning activities occur within a small footprint and livestock do not need to be relocated to other available pastures. An increase in available forage can reduce competition between livestock and other ungulates and it can potentially improve the number of livestock that can be grazed. Increased available forage on the forest from mechanical thinning should lead to improved opportunity to sustain livestock grazing and contribute to the socioeconomic wellbeing of ranching communities.

Prescribed fire in ponderosa pine forest and mixed conifer with frequent fire reduces the debris and litter on the forest floor and the number of smaller trees that prevent desired grasses and forbs from growing in

the forest understory. Prescribed burns can have the following short-term impacts to livestock grazing. Often livestock are removed from pastures and areas to be burned a year in advance to ensure existing understory grasses grow enough to carry a fire appropriately. After a burn, livestock are generally not reintroduced in the area for at least a year to let grasses and forbs regenerate. In the long term, prescribed burn areas would generally improve the amount and quality of forage available and reduce competition between livestock and other ungulates. Increased available forage on the forest from prescribed fire should lead to improved opportunity to sustain livestock grazing and contribute to the socioeconomic wellbeing of ranching communities.

Recreation activities continue across alternatives and have an emphasis on improving recreation opportunity and experience. This would potentially increase visitation to the forest. Livestock grazing exists throughout the forest and occasionally there are interfaces between various users and livestock. Forest users unfamiliar with livestock can be startled or unsettled by recreating where livestock are not behind a fence. This could potentially affect their recreation experience. Forest users also sometimes do not close livestock gates as they recreate on the forest. Leaving gates open could cause livestock to be in the wrong location during the wrong time of year impacting ecological condition and hardship on the livestock manager. The potential for increased visitation on the forest could lead to increased user interface on the forest.

Water quantity and water quality continue to be a concern for many as northern New Mexico has experienced drought since the mid-1990s and the trend is expected to intensify in the future across all alternatives. Available moisture can affect growing conditions for forage after restoration treatments. The potential to be off an allotment for longer than a year after a burn could occur in drought years, reducing available forage and potentially reducing stocking levels for affected permit holders. Drought could also affect forage regeneration and result in permit holders bringing livestock onto the forest later or taking them off sooner. Drought conditions can affect available water in streams and adjacent riparian areas. Alternatives 2, 3, 4, and 5 have plan direction to better address livestock grazing in these areas and improve range infrastructure to help move livestock watering away from these areas. This direction would improve forage and water availability, therefore, allowing livestock to graze their permitted season of use.

The Carson has approximately 110,000 acres of existing designated wilderness. Livestock grazing is allowed in all wilderness areas, but the use of motorized vehicles or equipment is not, which can limit or hinder the ability to effectively maintain existing infrastructure, under certain circumstances. No change to existing grazing management would be required by proposing research natural areas, though they would restrict future expansion of grazing in those areas.

Environmental Consequences for Sustainable Rangelands and Livestock Grazing - Alternative 1

In alternative 1, management of sustainable rangelands and livestock grazing would continue under the management area specific goals, objectives, standards, and guidelines in the 1986 Forest Plan (as amended). The primary purpose of mechanical harvesting in this alternative is to produce commercial timber, with the restoration of ponderosa pine forest and mixed conifer with frequent fire and subsequent improvement of understory grasses for forage as a secondary result of this activity. Alternative 1 identifies 1,000 acres per year of prescribed burning in ponderosa pine forest and none in mixed conifer with frequent fire. Continued management under the current 1986 Forest Plan would result in a continued loss of available grasses for forage, which could decrease the ability to graze livestock. Alternative 1 does not adequately address the design and installation of new range infrastructure that would improve the ability to manage livestock and reduce the detrimental effects to other ecological resources. This alternative does not identify the importance of livestock grazing to the socioeconomic stability of local communities. This alternative does not have any recommended wilderness.

Alternative 1 identifies revegetation management areas which preserves woodlands and ponderosa pine forest in a treeless state to promote forage production. Areas within this management area have been preserved in a treeless state for over 50 years. This management area would provide a beneficial effect to livestock grazing by continuing to increase forage availability for livestock and other ungulates. In non-drought years, this management area could potentially increase the number of livestock that can be grazed and reduce competition for forage with other ungulates.

Environmental Consequences for Sustainable Rangelands and Livestock Grazing – Alternative 2

Alternative 2 identifies a balance of mechanical treatment and prescribed fire as restoration tools in both ponderosa pine forest and mixed conifer with frequent fire. The amount of mechanical treatment and prescribed fire proposed is greatly increased in this alternative compared to alternative 1. This alternative also encourages managing naturally ignited wildfire when conditions are appropriate to move toward desired conditions for both vegetation communities. Where mechanical thinning and prescribed fire activities occur on the forest would be determined each year over the life of the plan. Vegetation treatment activities would be implemented to restore ecosystem health and over time should allow for more grasses for forage by livestock and other ungulates. More available forage could potentially increase the number of livestock that can be grazed and reduce competition for forage with other ungulates. Mechanical thinning activities would have minimal effect in the short term on the ability to graze, as livestock may have to be removed from the area treated for a short time.

The amount of prescribed fire would greatly increase in this alternative. The greater amount of prescribed fire in both ponderosa pine forest and mixed conifer with frequent fire would increase the short-term impacts on where livestock can be grazed, as livestock may have to be removed after treatment for a short time. Livestock grazing permit holders and Forest Service personnel would need to work collaboratively to manage allotments and pastures, both before and after prescribed fire activities, to determine when grazing would be appropriate. Depending on the size of a burn and the number of burns to take place, the number of livestock that could graze may need to be decreased to allow for effective burning. The long-term benefit would be an improvement to rangelands through increased forage availability for livestock and ungulates. Over the long term, assuming favorable climate conditions, livestock grazing permit holders may be able to increase the amount of livestock to be grazed (USDA FS Carson NF 2018a).

Alternative 2 has management direction better addressing livestock grazing near riparian areas. It addresses construction of new infrastructure, to be located away from and outside of riparian management zones. It requires improvement or maintenance of existing infrastructure in uplands to decrease the ground-disturbing effects to riparian areas. Alternative 2 direction addresses that range infrastructure should be designed to support livestock grazing activities and minimize impact the ecological condition and function of soils, streams, and riparian areas. Livestock grazing is one of several important multiple uses allowed on the forest. Similar to other activities on the forest, livestock grazing could have ground-disturbing effects (e.g., trampling, bank shearing) to other ecological resources. The revised plan language should help forest personnel implement projects and develop management strategies with grazing permit holders to manage livestock grazing to reduce ground-disturbing impacts while managing forage availability. When managed appropriately, grazing can reduce the risk of stand-replacing fire, reduce invasive species encroachment, and increase water availability for wildlife, which would beneficially affect all ecological resources.

Alternative 2 identifies the restoration of riparian areas to restore structure and function. It does not describe how to restore the riparian areas but, to improve riparian resources some potential protection measures, such as fencing, may be required that would decrease livestock grazing by reducing allotment acres and water availability. The plan also does not identify specific areas for restoration. Riparian

restoration treatment areas are generally not large in scale, so any decrease of water or forage availability for livestock could be mitigated and managed at the project level.

Livestock grazing has existed in northern New Mexico for hundreds of years. It is a large contributor to the economy of ranchers and local communities and is important to their culture. Alternative 2 has plan direction that recognizes the importance of livestock grazing and the importance of managing for sustainable rangelands to contribute to livestock grazing on the forest (USDA FS Carson NF 2018a). Recognizing the importance of livestock grazing should increase collaboration between the Forest Service and ranchers to develop projects that improve rangelands and reduce ground-disturbing impacts on other ecological resources by improving livestock grazing management on the Carson. It should also help to improve opportunities for ranchers to continue to graze on NFS lands (USDA FS Carson NF 2018a).

Alternative 2 includes 9,189 acres of recommended wilderness. It has language to continue to allow ranchers to use motorized vehicles, with a permit, to maintain existing infrastructure in areas that are recommended as wilderness until such time that the areas are either removed from consideration or designated as wilderness by Congress. Allowing motorized use, instead of only foot or horse travel, would decrease the cost and time for grazing permit holders to manage their allotments, thereby improving livestock management in these areas.

Alternative 2 identifies the grassland maintenance management area which preserves woodlands and ponderosa pine forest in a treeless state to promote forage production. Areas within this management area have been preserved in a treeless state for over 50 years. This management area would provide a beneficial effect to livestock grazing by continuing to increase forage availability for livestock and other ungulates forest wide. In non-drought years, this management area could potentially increase the number of livestock that can be grazed and reduce competition for forage with other ungulates (USDA FS Carson NF 2018a).

All action alternatives add plan components for the Rocky Mountain bighorn sheep in range to more clearly direct management emphasis on mitigating the potential for disease transmission to bighorn sheep from permitted domestic sheep or goats. The main differences between the action alternatives in regards to mitigating the potential for disease transmission to bighorn sheep from domestic sheep or goats is the flexibility of strategies (FW-GRZ-S-4) used to mitigate the potential for disease transmission to bighorn sheep from domestic sheep or goats. This will be discussed by alternative.

Alternative 2 includes plan component FW-GRZ-S-4 that states, "Domestic sheep allotments shall be managed (e.g., fencing, increased herding, herding dogs, potential vaccine, or other scientifically supported strategies) to mitigate the potential transfer of disease from permitted domestic sheep to bighorn sheep, wherever bighorn sheep occur." This standard will allow the flexibility to use the most appropriate management strategies for site-specific situations to mitigate the potential of disease transmission to bighorn sheep based on site-specific variables concerning topographic features of the landscape, herd dynamics, temporal and spatial information, and other best available science. These strategies could include, but are not limited to, double fencing or converting domestic sheep permits to cattle permits. This standard may increase cost to the permit holder depending on the appropriate management strategies, as they would have to pay for appropriate infrastructure to be able to manage domestic sheep or cattle in the area (USDA FS Carson NF 2018a).

Environmental Consequences for Sustainable Rangelands and Livestock Grazing – Alternative 3

Alternative 3 has more mechanical treatment than alternative 2 in ponderosa pine forest and mixed conifer with frequent fire and maintains the same amount of prescribed fire for restoration. The increased mechanical treatment would have minimal effect in the short-term on the ability to graze as livestock may have to be removed from the area treated for a short time. This alternative has the potential to have more

areas on the forest where vegetation would meet desired conditions, leading to increased available forage. More available forage could potentially increase the number of livestock that can be grazed and reduce competition for forage with other ungulates. Alternative 3 encourages the suppression of naturally ignited fires near suitable timber and trails. Suppression of naturally ignited fires could limit the opportunity to meet the acreage identified for prescribed fire, resulting in a decrease in locations where available forage is improved and increase livestock grazing.

Alternative 3 places an emphasis on motorized recreation opportunities, which could lead to increased, unwanted interfaces between forest users and livestock. Forest users unfamiliar with livestock can be startled or unsettled by recreating where livestock are not behind a fence. This could, potentially affect their recreation experience. Forest users also may sometimes not close livestock fences gates as they recreate on the forest. Leaving gates open could cause livestock to be in the wrong location during the wrong time of year impacting ecological condition and hardship on the livestock manager.

This alternative does not include the Valle Vidal and San Antonio Management Areas. These two management areas include contiguous lands that emphasize habitat for wildlife, including large ungulates. Managing these areas instead under forestwide direction would not impact livestock grazing or its associated management action.

Alternative 3 has zero acres of proposed recommended wilderness.

Alternative 3 identifies the Grassland Maintenance Management Area, which preserves woodlands and ponderosa pine forest in a treeless state to promote forage production. Areas within this management area have been preserved in a treeless state for over 50 years. This management area would provide a beneficial effect to livestock grazing by continuing to increase forage availability for livestock and other ungulates forestwide. In non-drought years, this management area could potentially increase the number of livestock that can be grazed and reduce competition for forage with other ungulates (USDA FS Carson NF 2018a).

All action alternatives add plan components for the Rocky Mountain bighorn sheep in range to more clearly direct management emphasis on mitigating the potential for disease transmission to bighorn sheep from permitted domestic sheep or goats. The main differences between the action alternatives in regard to mitigating the potential for disease transmission to bighorn sheep from domestic sheep or goats is the flexibility of strategies (FW-GRZ-S-4) used to mitigate the potential for disease transmission to bighorn sheep from domestic sheep or goats. This will be discussed by alternative. This alternative has the same standard as alternative 2, and the effects would be the same as discussed in alternative 2.

Environmental Consequences for Sustainable Rangelands and Livestock Grazing – Alternative 4

The primary difference between alternative 4 and the other alternatives is the greater use of naturally ignited wildfires and prescribed fires to achieve restoration objectives (125,000 to 225,000 acres during each 10-year period) under alternative 4. Mechanical treatment would focus on treating fuels to protect communities instead of forestwide restoration. More prescribed fire would increase short-term effects on the ability to graze as livestock may have to move off an allotment or pasture for a period both before and after a prescribed fire. This alternative would also increase the chance of stand-replacing wildfire, which would possibly eliminate forage for livestock grazing for several years decreasing economic and social benefits to the surrounding communities. Without mechanical treatment, the areas that are treated only with prescribed fire may not provide the same level of available forage as the combination of treatment activities utilized in alternative 2, and this may decrease livestock grazing and decrease economic and social benefits to the surrounding communities (USDA FS Carson NF 2018a).

Alternative 4 includes a standard that would not allow permitted domestic sheep grazing to overlap with bighorn sheep occupied habitat. This standard would require permit holders to convert to cattle on any area where there is overlap between domestic sheep and bighorn sheep. This standard would increase cost to the permit holder as they would have to pay for appropriate infrastructure to be able to manage cattle on the area (USDA FS Carson NF 2018a). If the permit holders could not convert to cattle, then domestic sheep would have to be relocated. This would result in a loss of income to the ranchers and a decrease in economic and social benefits to the surrounding communities (USDA FS Carson NF 2018a).

Alternative 4, which emphasizes natural processes, does not have the grassland maintenance management area. These areas would return to treed woodlands and ponderosa pine forest and would result in the loss in forage availability. The loss of forage availability would result in a loss in income if ranchers do not have other areas on the allotment to which to relocate and could result in an increased ungulate competition (USDA FS Carson NF 2018a). Alternative 4 includes the Valle Vidal and San Antonio management areas, neither of which would affect livestock grazing or its associated management. This alternative also includes the Wetland Jewel management area with plan components to improve certain wetland functions. There is no specific language addressing livestock grazing in this management area, but to improve wetland resources, some protection measures, such as fencing, may be required that would decrease livestock grazing by reducing forage and water availability. Alternatively, improved wetland function could increase available forage in the long term. The specific impacts from any management action on grazing would be determined at a project level within the Wetland Jewel Management Area. Work in these specific areas that encompass only a small percentage of the forest could result in a loss of income if ranchers do not have other areas on the allotment to relocate livestock during restoration (USDA FS Carson NF 2018a).

Alternative 4 has plan direction that prohibits the development of new springs on the forest. The development of a spring for livestock grazing can draw down some of the water that contributes to the function of the riparian area around the spring, but not having the opportunity to develop a spring may result in livestock and other ungulates using a desirable spring and trampling the riparian area associated with the spring. The inability to develop new springs could impact livestock and wildlife who rely upon developed springs when surface water is not available and could lead to increased competition elsewhere at nearby springs and/or riparian areas.

Alternative 4 recommends 45,473 acres of recommended wilderness, which is more than alternatives 1, 2, and 3. The plan has language to continue to allow ranchers to use motorized vehicles, with a permit, to maintain existing infrastructure in areas that are recommended as wilderness until such time they are removed from consideration or designated as wilderness by Congress. Allowing motorized use, instead of only foot or horse travel, would decrease the cost and time of grazing permit holders to manage their allotments, thereby, improving livestock management in these areas. This alternative includes recommended wilderness in ponderosa pine forest or mixed conifer with frequent fire that may otherwise benefit from vegetation treatments. The inability to do restoration treatments in these vegetation types can impact forage availability and increase the risk of stand-replacing fire. Decreased forage availability and increased risk of stand-replacing fire would result in a loss of income if ranchers do not have other areas on the allotment to relocate their livestock and could result in increased ungulate competition.

Environmental Consequences for Sustainable Rangelands and Livestock Grazing - Alternative 5

Alternative 5 would have the same impacts described in alternative 2 except for the amount of recommended wilderness. Alternative 5 has the most acres of recommended wilderness at 67,996 acres. The plan has language to continue to allow ranchers to use motorized vehicles, with a permit, to maintain existing infrastructure in areas that are recommended as wilderness until such time they are removed from consideration or designated as wilderness by Congress. Allowing motorized use, instead of only foot or

horse travel, would decrease the cost and time of grazing permit holders to manage their allotments, thereby, improving livestock management in these areas. This alternative includes recommended wilderness in ponderosa pine forest or mixed conifer with frequent fire that may otherwise benefit from vegetation treatments. The inability to do restoration treatments in these vegetation types can impact forage availability and increase the risk of stand-replacing fire. Decreased forage availability and increased risk of stand-replacing fire would result in a loss of income if ranchers do not have other areas on the allotment to relocate their livestock, and could result in increased ungulate competition (USDA FS Carson NF 2018a).

All action alternatives add plan components for the Rocky Mountain bighorn sheep in range to more clearly direct management emphasis on mitigating the potential for disease transmission to bighorn sheep from permitted domestic sheep or goats. The main differences between the action alternatives regarding mitigating the potential for disease transmission to bighorn sheep from domestic sheep or goats is the flexibility of strategies (FW-GRZ-S 4) used to mitigate the potential for disease transmission to bighorn sheep from domestic sheep or goats. This alternative has the same standard as alternative 2 and the effects would be the same as discussed in alternative 2.

Comparison of Alternatives for Sustainable Rangelands and Livestock Grazing

All the alternatives use either mechanical treatment and/or prescribed fire as restoration treatment methods that open up ponderosa pine forest and mixed conifer with frequent fire areas and increase available forage for livestock. Alternatives 2, 3, and 5 provide the best combination to provide available forage. Alternative 3 uses more mechanical treatment than 2 or 5, but the suppression of naturally ignited fires may limit the acreage that gets treated with fire.

Alternatives 1 and 3 do not have any recommended wilderness. Having no new recommended wilderness reduces the likelihood of any areas being designated as wilderness. Alternatives 2, 4, and 5 all have recommended wilderness, with 4 and 5 having the most. Alternative 2 balances restoration activities, which can improve grasses for forage, while providing recommended wilderness for primitive recreation opportunities.

Alternative 4 is the only alternative without the Grassland Maintenance Management Area, which manages these areas for grasses, provides available forage for livestock, and helps decrease competition for forage from other ungulates in adjacent areas with less forage. Alternative 3 does not have the Valle Vidal and San Antonio Management Areas, which have language to provide improved habitat conditions for wildlife and other ungulates. Management of these areas should maintain or improve forage availability for livestock.

Recreation exists across all alternatives and the concern for user and livestock interactions is fairly equal across all alternatives.

Restoration of riparian areas would occur across all alternatives but does not specifically prohibit livestock grazing in any area. Alternative 4 prioritizes where these activities would occur, which could limit management options for permit holders in these areas, even with site-specific project mitigation. Alternative 4 does not allow the development of new infrastructure in previously undeveloped springs, which could affect riparian areas and streams and impact availability of water for livestock and other ungulates. Not having the opportunity to develop a spring may result in livestock and other ungulates using a desirable spring and trampling the riparian area associated with the spring. The inability to develop new springs could impact livestock and wildlife who rely upon developed springs when surface water is not available and could lead to increased competition elsewhere at nearby springs and/or riparian areas.

Cumulative Environmental Consequences for Sustainable Rangelands and Livestock Grazing

This discussion considers impacts from the historic livestock use of the Carson NF from the current forest plan (approved in 1986) through the next planning period (15 years from today). The impacts from historic livestock grazing influences livestock management today. For example, areas that were once heavily grazed or improperly grazed are continuing to recover. Riparian areas altered by livestock use continue to recover. Fire suppression activities in the past have resulted in conifer encroachment in affected areas, which in turn can limit forage production and availability and affect livestock use and distribution patterns today.

Based on continuing and increasing public use, it is expected that the impact of recreational uses could increase as the population of local communities increases, and as more people nationwide continue to look for places to recreate. Vegetation management and the use of prescribed fire would likely increase to address vegetative health, fuel loads, and public safety. These trends could result in short-term expenses and long-term benefits to livestock grazing.

Livestock grazing is influenced by the multiple effects described throughout this analysis. These include effects that impact the allocation of forage resources between livestock and wildlife; predation and disease transmission; management adjustments to protect cultural resources; fisheries; threatened and endangered species; water quality; considerations necessary due to wildfire and prescribed fire management, and recreation. All these factors add to the complexity and expense for the ranching operations that are permitted to graze livestock on the Forest (Rimbey et al. 2015). Despite all these factors, continued demand and the need for livestock grazing is likely to remain at, or below, current levels. Livestock management is generally considered more difficult on NFS lands than on private lands for many of the reasons previously presented. In addition, the business of livestock management is subject to factors most often not under the control of livestock operators, such as tourism; land values, and potential subdivision of ranches; labor prices and availability; domestic and foreign demand for livestock products, markets and meat prices; Forest Service budgets and farm programs; fuel prices; predator control; social values; and Federal policy.

Because of, and in many cases despite of, the effects and unpredictability described above, livestock grazing is expected to continue at, or below, the current permitted level into the future (USDA FS Carson NF 2018a).

Sustainable Forestry and Forest Products

The Carson NF contains valuable timber resources and other forest products including mushrooms, wildings, medicinal plants, piñon nuts, and stone, among others. Timber and other products are resources in demand by local communities and the American public for building materials, fuel wood, posts and poles, food, medicine, and other uses. Timber harvest and other permitted forest product removal provide jobs and income through logging and manufacturing of wood products and the resale of other forest products.

The focus of the Carson timber program has shifted toward ecological restoration and reduction of wildfire hazard near communities. It includes the removal of small-diameter, insect-infested, and dead and dying trees. Timber production activities are considered tools that contribute to economical restoration and maintenance of ecosystem integrity and diversity, while supporting an economically viable wood products processing industry. In the future, an increasing level of commercial wood harvest will be necessary if restoration of desired conditions in forested vegetation communities at the plan scale is to be achieved.

The Carson's 1986 Forest Plan provides timber resource direction that generally prescribes a sustained yield from scheduled harvesting while considering other resource needs. In September 1996, the 1986 Forest Plan was amended to incorporate regional guidance for northern goshawk habitat and Mexican spotted owl recovery (USDA FS 1996). As a result, the Carson forestry program shifted emphasis from predominantly even-aged to predominantly uneven-aged forest management practices. In combination with waning budgets, the Carson gradually declined in forestry staffing, product outputs, and restoration accomplishments.

Although projects and activities addressing hazardous fuel loading had been a part of the vegetation management approach since at least the 1980s, the 2000 National Fire Plan (USDA and USDI 2000) provided directional emphasis to reduce the impacts of wildfires on communities and to restore fire-adapted ecosystems to healthy conditions. Carson's new forestry program directive was to further integrate with wildlife, watershed, and fuels management programs, subsequently providing wood products as a byproduct of other management objectives rather than as the primary objective.

Description of Affected Environment

Nearly 1.2 million acres (80 percent) of the Carson are considered forested, of which about 380,000 acres (26 percent) are currently considered suitable for timber production (USDA FS Carson NF 1986). The national Forest Inventory and Analysis program¹⁶ conducts an annual forest inventory of New Mexico forests. According to those plot data, summarized using Forest Inventory Data Online¹⁷ standard reports using 2005 to 2013 inventory data, gross standing tree volume on the Carson is about 1,936 million cubic feet (MMCF). These data also indicate average annual mortality of 27 MMCF (USDA FS 2019b).

Timber harvesting provides forest products that help support local wood processing industries and communities associated with those industries. It helps meet demands of the public for products such as lumber, fuelwood, vigas, and latillas. Timber harvest and forest thinning treatments are also important tools for shaping forest structure and composition to meet ecological integrity desired conditions and other objectives. Timber harvest may be used for improving wildlife habitat, increasing resiliency to disturbance such as fire, insects, and disease, and improving timber stand productivity. Approximately 37,000 acres of vegetation were treated on the Carson from fiscal year (FY) 2005 through FY 2014 (USDA FS Carson NF 1987). Treatments include activities such as timber harvesting, fuelwood gathering, small diameter thinning and/or mechanical fuels treatments, and prescribed burning.

Recent timber management objectives on the Carson have focused on forest ecosystem restoration, which includes improving forest resilience, watershed condition, and wildlife habitat, while reducing fire hazard (fuels management) and providing wood products to local communities. Total sale volume (i.e., timber sales, commercial and personal use fuelwood sales, post and pole permits, and other convertible product sales) averaged about 2 MMCF annually between FY 2005 and FY 2014. Fuelwood sales (personal and commercial) accounted for about 80 percent of the sale volume during this 10-year period.

The timber base draws mainly from the mixed conifer with frequent fire and ponderosa pine forest vegetation communities. Both of these communities are abundant on the landscape, but highly departed from historical conditions due to interruption of the natural fire regime and impacts from past land management activities. Due to the resultant changes in species composition and forest structure, both vegetation communities are vulnerable to uncharacteristic, high-severity wildfire and susceptible to mortality from a variety of insects and diseases. High-severity wildfire and insect- and disease-induced mortality can reasonably be expected to occur in these forests in the future, potentially exacerbating the

¹⁶ FIA data are publicly available from the national FIA website at fia.fs.fed.us. This site includes data downloads; online tools that allow users to perform custom queries; and documentation of FIA's field inventory protocols, database structure, and publications.

¹⁷ Available here: <http://fia.fs.fed.us/tools-data/default.asp>

current overabundance of even-aged, relatively young trees that did not exist under reference conditions. Large-scale disturbance could potentially affect the availability of timber resources in these forest types on the Carson, potentially necessitating a shift of harvest activity to other vegetation communities in the future. Timber harvest from other forest types would be more challenging, as traditional use of species from within the Mixed Conifer with Frequent Fire and Ponderosa Pine Forest vegetation communities is driven in part by ease of access (e.g., close proximity to communities, generally modest slopes, and higher road density). A more detailed analysis of ecological condition and trend by vegetation community can be found in the Vegetation and Fuels section of this document.

Timber harvest is allowed on lands not suitable for timber production for purposes such as salvage, fire management, insect and disease management, protection or enhancement of wildlife habitat, and recreation management. Timber harvest on these lands would have to be consistent with the desired conditions and objectives for the area. In recent years timber harvest in general, but in these areas in particular, has been minimal on the Carson.

Environmental Consequences for Sustainable Forestry and Forest Products

Methodology and Analysis

The 1976 National Forest Management Act and subsequent 2012 Planning Rule set specific requirements regarding timber harvest. The 2012 Planning Rule requires an estimate of the sustained yield limit of timber that may be removed from the Carson. It also requires that the plan contain direction as to the types of forest harvesting methods to be used and the size and location of timber harvests. Forest plans do not authorize any particular timber harvest, but merely identify what portions of the forest would be suitable for timber production on a regulated basis and what constraints might apply.

Timber suitability was determined using the Carson Terrestrial Ecosystem Survey (USDA FS Carson 1987) and geographic information related to existing legal prohibitions and plan components by alternative. Criteria for suitability are defined in the 2012 Planning Rule at 36 CFR 219.11 and in the Forest Service Handbook 1909.12, chapter 60. The specific process and criteria used are detailed in appendix D.

Timber harvest was modeled using the Forest Vegetation Simulator to estimate the sustained yield limit, as described in appendix D. Planned treatment types and management levels were developed consistent with the theme and objectives for each alternative, and volumes by treatment type were also modeled with Forest Vegetation Simulator. Together this information produced estimates for projected timber sale quantity and projected wood sale quantity, by alternative (see appendix D).

Planned treatment types and management levels were used to compare effects to timber and other wood product harvest under each alternative. These management activities were evaluated in relation to their effects on availability of forest products for personal and business uses, availability of forest products for traditional use, and commercial timber opportunity to support restoration. To make broad comparisons between alternatives, this programmatic analysis uses:

- The amount and location of recommended wilderness and other management areas that affect the suitable timber base.
- Transportation and access objectives related to roads.
- Wildland fire management guidelines related to suitable timber areas.

Assumptions

Forest products are expected to be a primary driver in selecting among alternatives because of predicted impacts between alternatives with regard to the amount of fuelwood available, the economic impact from

the timber processing industry, and the cost offset of forest restoration from commercial operations. Differences between alternatives exist because:

- The amount of commercial and non-commercial mechanical wood harvest varies among alternatives. The capacity to provide forest products such as fuelwood, vigas, and timber for personnel and commercial use would be dependent on the anticipated rate of harvest.
- Dead and down fuelwood volume removed is based on public demand and does not vary among alternatives. It is estimated based on the recent average of 8.7 million cubic feet per decade and held constant across all alternatives.
- All projects implemented on the Carson require a site-specific analysis of their effects.
- Potential environmental impacts, compatibility with desired conditions, necessary mitigations, and contribution to providing forest products.
- Some alternatives prohibit future site-specific commercial timber harvesting in specific locations.

Indicators

- Number of acres available for regulated timber harvest (suitable timber).
- Projected volume of sawtimber.
- Projected volume of other wood products (e.g., poles, posts, fuelwood).
- Level of motorized access for the collection of other forest products (e.g., mushrooms, piñon nuts, stone).

Environmental Consequences for Sustainable Forestry and Forest Products Common to All Alternatives

All alternatives contain plan direction to provide a sustainable supply of forest products with consideration to multiple-use objectives, consistent with desired conditions of other resources. Desired conditions promote the sustainable availability and removal of forest products, associated with silvicultural treatments that contribute to ecosystem integrity. Forest products contribute to local economies and livelihoods, creating opportunities to sustain existing industries or develop new industries based on the availability of supplies and needs of the people. Forest products also support traditional communities and culturally important activities and contribute to the long-term socioeconomic diversity and stability of local communities by providing a sustainable and continuous supply of products to meet demand. While the availability and accessibility of traditionally used forest products may vary by alternative, the demand for these products is not anticipated to change, resulting in varying levels of support for traditional communities among alternatives.

All alternatives have the potential for some level of timber harvest to support local and regional markets and contribute financially to area residents. All alternatives include mechanical treatment for fuels reduction, forest restoration, or both, any of which may produce commercial timber, small-diameter timber, biomass, or fuelwood as a by-product. All alternatives provide opportunities for the public to collect other forest products under permit and for unpermitted personal use.

There would be potential watershed, soil, wildlife, vegetation, and other impacts associated with all planned forest product removal that would be managed at the project level and in accordance with plan components for those resource areas. Machinery used for commercial timber harvesting or non-commercial thinning can cause soil compaction, leading to reduced water infiltration rates, increased water runoff and soil erosion, and reduced soil productivity. Mechanical treatments may also necessitate the reopening of or creation of new roads, leading to greater fragmentation of wildlife habitat and

disruption of surface hydrology. Tree removal may also negatively impact the aesthetic quality of an area in the short-term, leaving an unnatural appearance.

Other effects of forest product removal would move resources toward desired conditions. The removal of some forest products would reduce competition for resources, ease drought stress, and increase the health and vigor of residual vegetation. Thinning of overstocked forests can maintain forest structural stage distribution, lead to higher quality timber in the future, control insect and disease infestations, improve forage availability for wildlife, and reduce watershed risks from high intensity fire.

Timber production is the purposeful growing, tending, harvesting, and regeneration of regulated crops of trees to be cut into logs, bolts, or other round sections for industrial or consumer use (36 CFR 219.19). It may be a component of other activities such as restoration or fuels treatments since timber products may result from other types of wood harvest as a byproduct of meeting other objectives. Under all alternatives, other types of forest treatment that may produce timber would occur on lands not suitable for timber production. Alternately, areas that are determined suited for timber production can be treated to increase ecosystem resiliency while also providing a commercial timber product to generate revenue on the Forest. The number of acres suitable for timber production differs by alternative mainly as a result of management area plan direction (e.g., recommended wilderness, San Antonio and Valle Vidal management areas). Each alternative provides sufficient opportunities to meet mechanical treatment and sustainable forestry objectives (see appendix D).

Providing a suitable land base for timber production has the potential to increase revenue to local and regional communities through the creation of more job opportunities and expanded timber-related industries. The creation or expansion of timber-related industry would also lessen fire suppression costs by encouraging the continued extraction of fuels that make fire suppression difficult, and could lessen smoke outputs during fires due to reduced availability of fuels to burn. Due to the overstocked nature of the Carson's frequent fire forest communities, new industry that would use small-diameter stems, would help to reduce these overstocked conditions, and move forests toward desired conditions. Creating a market or increased demand for small-diameter stems would also provide an alternative to the pile and burn method commonly used to remove these woody residues following non-commercial fuel reduction treatments, reducing smoke outputs that can impact human health.

Environmental Consequences for Sustainable Forestry and Forest Products – Alternative 1

There would be 382,355 acres of land suitable for timber production under alternative 1. This is nearly unchanged from the suitable area under the current plan (380,000 acres). Like the current plan, alternative 1 would continue to use diameter cap limits for some thinning prescriptions, and most mechanical treatment would remove only small trees (see appendix D).

Table 50 displays the timber and wood products outputs under alternative 1. The sustained yield limit is 422 million board feet (MMBF), 107 million cubic feet (MMCF) per decade.

Wood products, including commercial timber, would continue to be removed from the forest at about the same rate as they have been during the last decade. An average of 4.95 MMCF of timber would be produced per decade. Total wood sale quantity, including hardwoods and non-industrial products, would average 10.7 MMCF per decade (table 50). These outputs reflect only green wood (cutting live trees); they do not include dead and down fuelwood permits, which account for a large proportion of the total wood removal on the Carson, currently an additional 8.7 MMCF per decade (table 51). The emergence of new timber markets or any significant growth of existing markets would be least likely under this alternative, resulting in little change to the demand for timber products and negligible additional economic benefit.

Alternative 1 provides the basis for comparison with the four action alternatives. See table 52 for a comparison of jobs and timber based labor income.

Table 50. Timber and wood products outputs under alternative 1

Timber Products	Decade 1 MMCF	Decade 1 MMBF	Decade 1 tons	Decade 2 MMCF	Decade 2 MMBF	Decade 2 tons
Lands suitable for timber production ¹ A1. Sawtimber (industrial softwoods, 9"+)	1.0	4.4	15,273.0	1.6	7.3	23,883.2
Lands suitable for timber production ¹ A2. Other Products (industrial softwood, 5-9" - roundwood, commonly pulpwood, mostly in the form of fuelwood)	0.4	not applicable	59,260.9	0.4	not applicable	47,450.5
Lands not suitable for timber production B1. Sawtimber (9"+)	2.0	9.1	30,971.1	2.9	13.0	43,929.2
Lands not suitable for timber production B2. Other Products (5-9")	0.7	not applicable	102,384.9	0.8	not applicable	83,367.5
C. Projected Timber Sale Quantity (A1+A2+B1+B2)	4.1	13.5	207,890	5.8	20.3	198,630
Other estimated wood products ² D1. Non-industrial softwood fuelwood (5"+)	5.3	not applicable	1.5	5.4	not applicable	1.5
Other estimated wood products ² D2. Hardwood fuelwood (5"+)	0.3	not applicable	0.1	0.3	not applicable	0.1
Other estimated wood products ² D3. Aspen (5"+)	0.1	not applicable	0.0	0.2	not applicable	0.0
E. Projected Wood Sale Quantity (C+D1+D2+D3)	9.8	not applicable	207,892	11.6	not applicable	198,632

1. Volumes other than salvage or sanitation that meet timber product utilization standards
2. Fuelwood, biomass, and other volumes that do not meet timber product utilization standards

Table 51. Estimated output of other forest products under each alternative

Alternative	Poles MMCF/decade	Posts MMCF/decade	Fuelwood* MMCF/decade
1	0.56	0.003	15.5
2	0.79	0.004	22.0
3	1.29	0.006	30.8
4	.44	0.002	12.1
5	.79	0.004	22.0

*Green industrial softwoods, non-industrial softwood and hardwood, plus dead and down.

Table 52. Jobs and income from timber under each alternative (USDA FS Carson NF 2018a)

Alternative	Timber jobs contributed	Timber labor income (2016 \$s)
1	31	\$1,359,000
2	244	\$10,917,000
3	486	\$21,802,000
4	31	\$1,385,000
5	244	\$10,917,000

Environmental Consequences for Sustainable Forestry and Forest Products - Alternative 2

There would be 455,844 acres of land suitable for timber production under alternative 2. The additional acres, compared to alternative 1, are mostly in the Valle Vidal Management Area, which is unsuitable under alternative 1. Almost all mechanical treatment would be either group-selection cuts or thin-from-below cuts based on a target forest structure, composition, and basal area rather than a diameter cap (see appendix D). Group-selection harvests combined with periodic selection or variable density thinning, would achieve restoration objectives, maintain habitat connectivity, and contribute a dependable flow of forest products to existing and prospective local industry. Table 53 details the timber and wood product outputs under alternative 2. The sustained yield limit is 422 MMBF, 107 MMCF per decade.

Wood products, including commercial timber, would be removed from the forest at an average of 41.0 MMCF per decade under alternative 2. Total wood sale quantity, including hardwoods and non-industrial products, would average 48.9 MMCF per decade (table 53). These outputs reflect only green wood (cutting live trees). Total fuelwood, including dead and down removal is estimated to be 22.0 MMCF per decade under alternative 2 (table 51).

Table 53. Timber and wood product outputs under alternative 2

Timber Products	Decade 1 MMCF	Decade 1 MMBF	Decade 1 tons	Decade 2 MMCF	Decade 2 MMBF	Decade 2 tons
Lands suitable for timber production ¹ A1. Sawtimber (industrial softwoods, 9"+)	12.9	60.3	192,728.5	13.3	64.6	196,476.0
Lands suitable for timber production ¹ A2. Other Products (industrial softwood, 5-9" - roundwood, commonly pulpwood, mostly in the form of fuelwood)	2.4	not applicable	102,519.0	2.1	not applicable	82,378.2
Lands not suitable for timber production B1. Sawtimber (9"+)	20.8	98.1	311,883.1	22.9	113.2	338,618.3
Lands not suitable for timber production B2. Other Products (5-9")	4.1	not applicable	136,558.8	3.6	not applicable	112,009.6
C. Projected Timber Sale Quantity (A1+A2+B1+B2)	40.1	158.5	743,689	41.9	177.8	729,482
Other estimated wood products ² D1. Non-industrial softwood fuelwood (5"+)	5.9	not applicable	1.6	6.5	not applicable	1.8
Other estimated wood products ² D2. Hardwood fuelwood (5"+)	1.1	not applicable	0.4	1.0	not applicable	0.4
Other estimated wood products ² D3. Aspen (5"+)	0.7	not applicable	0.2	0.6	not applicable	0.1
E. Projected Wood Sale Quantity (C+D1+D2+D3)	47.8	not applicable	743,692	50.0	not applicable	729,484

1. Volumes other than salvage or sanitation that meet timber product utilization standards

2. Fuelwood, biomass, and other volumes that do not meet timber product utilization standards

Alternative 2 would provide substantially more wood products, both industrial timber (978 percent increase in the first decade) and fuelwood (142 percent increase in the first decade). The opportunity to collect other forest products would be similar to what it is currently and similar to what it would be under alternative 1. Alternative 2 would produce 213 more jobs in the timber industry and add over \$9 million

of timber-based labor income compared to alternative 1, provided suitable markets and industry are present (table 52). The expanded timber industry would increase revenue in local and regional communities, reduce fire suppression costs, reduce smoke produced by wildfires, and reduce overstocked stand conditions. Compared to alternative 1, mechanical treatment would be more economically efficient because there would be more timber revenue to offset costs.

Environmental Consequences for Sustainable Forestry and Forest Products - Alternative 3

There would be 458,724 acres of land suitable for timber production under alternative 3. This is nearly the same as alternative 2. The rate of mechanical treatment would be increased and, like alternative 2, almost all mechanical treatment would be either group-selection cuts or thin-from-below cuts based on a target forest structure, composition, and basal area rather than a diameter cap (see appendix D). Like alternative 2, group selection harvests combined with periodic selection or variable density thinning, would achieve restoration objectives, maintain habitat connectivity, and more than any other alternative, increase the flow of forest products to existing and prospective local industry.

Refer to table 54 for timber and wood product outputs under alternative 3. The sustained yield limit is 422 MMBF, 107 MMCF per decade.

Wood products, including commercial timber, would be removed from the forest at a rate of 103.4 MMCF in the first decade under alternative 3, but would drop to just 61.2 MMCF by the second decade as dense forests are thinned and opportunities to remove large trees decline. Total wood sale quantity, including hardwoods and non-industrial products, would be 117.6 MMCF in the first decade, dropping to 72.0 MMCF by the second (table 54). These outputs reflect only green wood (cutting live trees). Total fuelwood, including dead and down removal, is estimated to be 30.8 MMCF per decade under alternative 3 (table 51).

Alternative 3 would provide more wood products than any other alternative, especially in the first decade. Compared to alternative 1, industrial timber production would increase by more than 2,500 percent in the first decade and fuelwood output would nearly double. There would be more opportunities to collect other forest products compared to all other alternatives, because it is more likely that more roads would be left open to the public. Alternative 3 would produce the greatest number of jobs and produce the most timber-based labor income provided suitable markets and industry are present (table 76). The expanded timber industry would increase revenue in local and regional communities, reduce fire suppression costs, reduce smoke produced by wildfires, and reduce overstocked stand conditions more than any other alternative. Improving motorized access to forest products could be especially advantageous for citizens who have mobility challenges or are elderly, alleviating the challenges associated with non-motorized transportation and accommodating a wider range of forest users.

Table 54. Timber and wood product outputs under alternative 3

Timber Products	Decade 1 MMCF	Decade 1 MMBF	Decade 1 tons	Decade 2 MMCF	Decade 2 MMBF	Decade 2 tons
Lands suitable for timber production ¹ A1. Sawtimber (industrial softwoods, 9"+)	36.4	170.7	544,950.4	24.2	115.6	358,854.0
Lands suitable for timber production ¹ A2. Other Products (industrial softwood, 5-9" - roundwood, commonly pulpwood, mostly in the form of fuelwood)	6.3	not applicable	162,194.8	3.8	not applicable	108,995.5
Lands not suitable for timber production B1. Sawtimber (9"+)	51.4	247.0	769052.4	28.3	139.0	417,979.6
Lands not suitable for timber production B2. Other Products (5-9")	9.2	not applicable	210073.2	5.0	not applicable	132,262.6
C. Projected Timber Sale Quantity (A1+A2+B1+B2)	103.4	417.7	1,686,271	61.2	254.7	1,018,092
Other estimated wood products ² D1. Non-industrial softwood fuelwood (5"+)	7.7	not applicable	2.1	7.0	not applicable	1.9
Other estimated wood products ² D2. Hardwood fuelwood (5"+)	3.4	not applicable	1.3	1.6	not applicable	0.6
Other estimated wood products ² D3. Aspen (5"+)	3.0	not applicable	0.7	2.1	not applicable	0.5
E. Projected Wood Sale Quantity (C+D1+D2+D3)	117.6	not applicable	1,686,275	72.0	not applicable	1,018,095

1. Volumes other than salvage or sanitation that meet timber product utilization standards

2. Fuelwood, biomass, and other volumes that do not meet timber product utilization standards

Environmental Consequences for Sustainable Forestry and Forest Products - Alternative 4

There would be 351,970 acres of land suitable for timber production under alternative 4. Lands in the San Antonio and Valle Vidal Management Areas would be unsuitable, resulting in the least amount of land suitable for timber production of any alternative, and less than is currently suitable. The rate of mechanical treatment would be the same as alternative 1, and well below all other action alternatives. But unlike alternative 1, all mechanical treatment would be expected to occur in the wildland-urban interface for fuels management. Nearly all that treatment would be thinning-from-below based on a target basal area (see appendix D). Alternative 4 would be the least effective at achieving restoration objectives or maintaining habitat connectivity. Compared to alternative 2, mechanical treatment would be less economically efficient because there would be much less timber revenue to offset costs. Sustained yield limit is 422 MMBF, 107 MMCF per decade.

Wood products, including commercial timber, would be removed from the forest at an average of 5.1 MMCF per decade under alternative 4. Total wood sale quantity, including hardwoods and non-industrial products, would average 7.7 MMCF per decade (see table 55). These outputs reflect only green wood (cutting live trees). Total fuelwood, including dead and down removal is estimated to be 12.1 MMCF per decade under alternative 4 (table 51).

Table 55. Timber and wood product outputs under alternative 4

Timber Products	Decade 1 MMCF	Decade 1 MMBF	Decade 1 tons	Decade 2 MMCF	Decade 2 MMBF	Decade 2 tons
Lands suitable for timber production ¹ A1. Sawtimber (industrial softwoods, 9"+)	1.6	7.2	24,545.5	1.8	8.4	26,412.9
Lands suitable for timber production ¹ A2. Other Products (industrial softwood, 5-9" - roundwood, commonly pulpwood, mostly in the form of fuelwood)	0.4	not applicable	57,155.0	0.3	not applicable	44,116.0
Lands not suitable for timber production B1. Sawtimber (9"+)	2.4	10.8	36,388.7	2.2	10.2	33,229.2
Lands not suitable for timber production B2. Other Products (5-9")	0.8	not applicable	106,493.0	0.7	not applicable	83,230.5
C. Projected Timber Sale Quantity (A1+A2+B1+B2)	5.2	18.0	224,582	5.0	18.5	186,988
Other estimated wood products ² D1. Non-industrial softwood fuelwood (5"+)	1.8	not applicable	0.5	2.3	not applicable	0.6
Other estimated wood products ² D2. Hardwood fuelwood (5"+)	0.3	not applicable	0.1	0.2	not applicable	0.1
Other estimated wood products ² D3. Aspen (5"+)	0.4	not applicable	0.1	0.2	not applicable	0.1
E. Projected Wood Sale Quantity (C+D1+D2+D3)	7.6	not applicable	224,583	7.8	not applicable	186,989

1. Volumes other than salvage or sanitation that meet timber product utilization standards

2. Fuelwood, biomass, and other volumes that do not meet timber product utilization standards

Alternative 4 would provide about the same volume of wood products as alternative 1, well below alternative 2. Total wood sale quantity and the volume of fuelwood would be the lowest of any alternative. The opportunity to collect other forest products would be somewhat more limited compared to alternative 2, because of seasonal closures in the San Antonio Management Area and Valle Vidal Management Area, and less likelihood of roads remaining open to the public forestwide. The ability of the forest to sustain these traditional uses would be lower than under any other alternative.

The number of jobs in the timber industry and timber-based labor income would both be similar to alternative 1 and well below alternative 2 (table 52). The potential for new timber markets or any significant growth of existing markets would be about the same as under alternative 1, resulting in little change to the demand for timber products and negligible additional economic benefit. There would be the potential for slightly more commercial timber which could have some benefit in terms of increased revenue in local and regional communities. However, total material removed would be lower than any other alternative and would have the least benefit in terms of reducing fire suppression costs, smoke production, or overstocked stand conditions.

Environmental Consequences for Sustainable Forestry and Forest Products - Alternative 5

There would be 440,550 acres of land suitable for timber production under alternative 5, about 15,000 acres fewer than alternative 2 because of the additional recommended wilderness areas. As in alternative 2, almost all mechanical treatment would be either thin-from-below or group-selection cuts based on a target forest structure, composition, and basal area rather than a diameter cap (see appendix

D). Refer to table 56 for timber and wood product outputs under alternative 5. The sustained yield limit is 422 MMBF, 107 MMCF per decade

Table 56. Timber and wood product outputs under alternative 5

Timber Products	Decade 1 MMCF	Decade 1 MMBF	Decade 1 tons	Decade 2 MMCF	Decade 2 MMBF	Decade 2 tons
Lands suitable for timber production ¹ A1. Sawtimber (industrial softwoods, 9"+)	12.6	59.0	188639.0	13.0	63.3	192583.5
Lands suitable for timber production ¹ A2. Other Products (industrial softwood, 5-9" - roundwood, commonly pulpwood, mostly in the form of fuelwood)	2.3	not applicable	101333.2	2.0	not applicable	81401.0
Lands not suitable for timber production B1. Sawtimber (9"+)	21.1	99.4	315972.7	23.2	114.5	342510.8
Lands not suitable for timber production B2. Other Products (5-9")	4.1	not applicable	137744.7	3.7	not applicable	112986.8
C. Projected Timber Sale Quantity (A1+A2+B1+B2)	40.1	158.5	743,689	41.9	177.8	729,482
Other estimated wood products ² D1. Non-industrial softwood fuelwood (5"+)	5.9	not applicable	1.6	6.5	not applicable	1.8
Other estimated wood products ² D2. Hardwood fuelwood (5"+)	1.1	not applicable	0.4	1.0	not applicable	0.4
Other estimated wood products ² D3. Aspen (5"+)	0.7	not applicable	0.2	0.6	not applicable	0.1
E. Projected Wood Sale Quantity (C+D1+D2+D3)	47.8	not applicable	743,692	50.0	not applicable	729,484

1. Volumes other than salvage or sanitation that meet timber product utilization standards

2. Fuelwood, biomass, and other volumes that do not meet timber product utilization standards

Wood products, including commercial timber, would be removed from the forest at an average of 41.0 MMCF per decade under alternative 5. Total wood sale quantity, including hardwoods and non-industrial products would average 48.9 MMCF per decade (table 56). These outputs reflect only green wood (cutting live trees). Total fuelwood, including dead and down removal is estimated to be 22.0 MMCF per decade under alternative 5 (table 51).

Alternative 5 would be identical to alternative 2 in terms of timber and wood volume produced, timber jobs contributed, and timber labor income contributed (table 51 through table 53). The opportunity to collect other forest products would be similar to what it is currently and similar to what it would be under alternative 1. For the most part, recommended wilderness areas would have negligible impacts on the collection of forest products based on where that collection currently occurs. There may be some localized impacts on the ability to collect fuelwood associated with the Tres Piedras, Canjilon Meadows, and Comanche recommended wilderness management areas because those areas may have some fuelwood collection currently occurring that would no longer be allowed. While the removal of other forest products is generally not compatible with the “essentially unmodified” desired condition in recommended wilderness (DA-RWMA-DC-3), enough opportunity is available in other places on the Carson to meet current and anticipated future demand.

Cumulative Environmental Consequences for Sustainable Forestry and Forest Products

The Carson National Forest is adjacent to two other national forests (Santa Fe National Forest and Rio Grande National Forest), as well as BLM, tribal, State, and privately owned lands. Within the broader landscape, timber production is a minor component of employment. In 2012, timber-related jobs accounted for less than 1 percent of private sector employment within Colfax, Mora, Rio Arriba and Taos Counties (Headwater Economics 2015). There are no industrial timberlands within the 4-county area. Collectively, timber harvest within these counties averaged 1.6 MMCF per year from 2002 through 2012. From 2002 through 2012, tribal and private timberlands provided an average of 73 percent of the timber products received by mills throughout New Mexico; whereas, national forests provided 26 percent of the volume on average (Sorensen et al. 2012). According to the University of Montana's Bureau of Business and Economic Research, there were eight active primary wood products facilities within Colfax, Mora, Rio Arriba, and Taos Counties in 2012 (Sorensen et al. 2012). Wood products from these facilities include lumber, vigas, latillas, and other products.

Many factors influence timber harvest. The demand for timber products, supply from other sources, laws, and regulations all affect the amount of timber that may be harvested from the Carson now and in the future. Budgets and the project planning process also impact timber supply potential. What follows is a brief description of some influences that are changing or may change in the future, adding to the effects of this plan on timber harvest.

The demand for timber products is a driver of the volume of timber supplied. If markets improve and regional demand for wood products increases, there would be more desire for timber from the Carson. Alternatively, if demand decreases and sawmills close, there may be less desire for timber from the Carson. A decrease in demand would likely reduce the amount of timber that would be sold.

The supply of timber from tribal, private, State lands, and adjacent national forests impacts the demand for timber from the Carson. Were timber supplies from other lands to decrease, there would be increased demand on the Carson. Conversely, if supplies from other lands increased, it may decrease demand on the Carson. When forest products are available from adjacent lands, the impact and dependence on the Carson for these products would be lessened.

The variability in demand for timber products makes the effects of past, present, and reasonably foreseeable future actions difficult to assess. However, adjacent national forests are also currently revising plan direction to increase the pace of forest restoration. That combined impact of more available timber and other wood product volume should improve opportunities in the timber processing industry. Opportunities for products that originate from small diameter stems would be the most likely to increase due to the abundance of this size class of trees on the landscape. Industry that is able to take advantage of that opportunity could significantly benefit local economies in the future. As a restoration economy develops in the region it is likely to create additional money and jobs even if there is not an expanded market for non-commercial wood products.

Forest products other than commercial timber, such as fuelwood, food like piñon nuts and mushrooms, and medicinal plants like osha can be accessed on other public lands, but national forests fill a specific niche because of the landscapes that they contain and the public access that they provide. BLM and state lands provide access to fuelwood and piñon nuts. Tribal lands provide access to a variety of products, but are not accessible by the general public. The Carson, Santa Fe, and Rio Grande National Forests provide similar opportunities that are somewhat unique in the area because they provide the public with forest products from higher elevation forest types that are less common on other public lands. The Carson and Santa Fe National Forests, in particular, are in alignment in their recognition of the importance for providing forest products to local communities for traditional use and economic benefit. The revised Rio Grande National Forest plan also includes new recognition of the socioeconomic role that the forest plays.

Together, these revised plans should improve and sustain the availability of forest products and support cultural and economic needs of regional communities.

Recreation

The Carson offers a wide variety of dispersed and developed recreational opportunities. Its varying elevations and climatic zones allow year-round visitation. Elevations range from 6,000 to over 13,000 feet at Wheeler Peak (13,161 feet elevation), the highest peak in New Mexico. The east side of the forest (Questa and Camino Real Ranger Districts) has most of the forest's motorized and non-motorized trails, most of the developed recreation facilities, three alpine ski areas, and one developed Nordic ski area. The forest's high elevation alpine environment draws visitors from several states (e.g., New Mexico, Texas, Oklahoma, Louisiana, Arkansas, Colorado, and others) to escape from the heat during the summer and for the snow sport opportunities in the winter (USDA FS 2009b).

The Carson is an important recreation destination in New Mexico, because of its proximity to the cities of Albuquerque, Santa Fe, Los Alamos, and Española, the incorporated towns and villages of Taos, Red River, Questa, and Taos Ski Valley, and the Rio Grande del Norte National Monument (administered by the BLM). Furthermore, many local residents have a long-term connection with the forest for day-use recreation, fuelwood, and piñon nut picking, annual gatherings, holiday celebrations, and hunting. High visitation from nearby urban areas occurs across the forest on summer weekends and holidays. During the winter, visitation is more concentrated around the ski areas located on and near the forest. In New Mexico, outdoor recreation generated over 99,000 direct jobs producing \$2.8 billion in wages and salaries. Outdoor recreation generates \$9.9 billion in consumer spending annually in New Mexico, producing \$623 million in state and local tax revenue (Outdoor Industry Association 2017). Of the Carson National Forest's estimated one million visitors, 89 percent come for recreational pursuits (USDA FS Carson NF 2015a).

The Carson contains a large portion of the headwaters of the Rio Grande and Rio Chama and is the source of water for many other lakes and streams. The abundance of water is a major draw for visitors coming to the forest. Most developed recreation facilities are located to take advantage of these features. The Carson also offers exceptional opportunities for dispersed recreation and for solitude. The east and west sides of the forest provide dispersed recreation; however, the west side (Tres Piedras, Canjilon, and El Rito Ranger Districts) is known for offering a wide variety of dispersed activities and is heavily used during the fall hunting season. The few developed recreation facilities on the west side are extremely popular, especially among local residents from nearby urban areas of the state. The Jicarilla Ranger District is known for its quality mule deer hunting and is most popular for recreationists during the fall hunting season.

Description of Affected Environment

The Carson offers a variety of developed and dispersed recreational activities including camping and picnicking, hiking, mountain biking, horseback riding, wildlife and scenic viewing, hunting and fishing, snow sports, and rock climbing.

Dispersed Recreation

Dispersed recreation is the most popular form of recreation on the Carson, including dispersed camping, hiking, mountain biking, horseback riding, scenic viewing, wildlife viewing, fishing, hunting, and cross-country skiing. Trail use is the most popular dispersed recreation activity in both the summer and winter. Dispersed camping, primarily occurring adjacent to Forest Service roads or water sources, is also a popular activity enjoyed by small and large groups.

Use trends tend to follow the population centers around the forest for dispersed recreation. Higher use rates occur near small towns where people can go for a quick outing without having to venture far. Trails around local communities are popular for quick hikes over shorter distances.

With trail use making up the most popular dispersed recreation activity on the Carson, trail opportunities have not kept up with user demand. For example, mountain biking and motorized trail opportunities on the forest are scarce compared to the demand.

Trail maintenance also lags behind need on the Carson. One trail crew works approximately half of the year, and destination trails such as Wheeler Peak, South Boundary, and trails in Hondo Canyon and the Pecos Wilderness usually receive annual routine maintenance, while other trails on the forest receive little to no maintenance, despite trail use being one of the largest demands on the forest.

Group camping is another activity enjoyed in undeveloped forest areas. Some of the most popular dispersed camping by larger groups tends to take place by water features, such as streams or riparian areas. The Carson is often sought for large family camping and group gatherings.

The implementation of the Travel Management Rule (36 CFR Parts 212, 251, 261, and 295), eliminated motorized cross-country travel on the Carson. The public can no longer drive off Forest Service roads to camp in large portions of the forest. The final travel management decisions for the Carson did designate 300-foot corridors on 785 miles of open road and 150-foot corridors on 451 miles of open road, where the public is allowed to drive off the road and camp (USDA FS Carson NF 2010a, 2010b, 2011, 2013).

The opportunity to hunt, fish, or just commune with nature is a very important form of dispersed recreation. Hunting, fishing, and wildlife viewing in the plan area contribute to economic sustainability through employment opportunities, support of small businesses, and Federal receipts shared with local governments. In 2013, New Mexico Department of Game and Fish (NMDGF) commissioned a study of fishing, hunting, and other wildlife associated activities to estimate county-level and state-wide contribution to the state's economy (Southwick Associates 2014). The study found 247,600 New Mexico residents and nonresidents fished (160,000), hunted (86,000), or participated in other wildlife-associated activities (1,600) in New Mexico in 2013. Of these participants, 42 percent (103,710) fished, hunted, or viewed wildlife in the four counties encompassing the Carson. These participants spent approximately \$84,814,599 on these activities.

Developed Recreation

The Carson has many developed campgrounds, trailheads, interpretative sites, and fishing sites. Developed campgrounds are typically open from Memorial Day through Labor Day weekend. Use is highest during July and on holiday weekends.

Most developed trailheads are near State highways and can be accessed year-round. Remote trailheads accessed from Forest Service roads are typically inaccessible in the winter due to seasonal closures or poor road conditions.

Snow skiing is the second most popular activity on the Carson. Taos Ski Valley, Red River Ski and Summer Resort, and Enchanted Forest Cross-country and Snowshoe Area are located on the Questa Ranger District. Sipapu Ski and Summer Resort is on the Camino Real Ranger District. In addition to winter ski area operations, the four ski areas promote other year-round recreation activities within their permit areas. Developed ski areas are important contributors to the Carson NF's recreational opportunities and to the economic vitality of surrounding local communities.

The condition and use of developed recreation facilities on the Carson vary greatly and are dependent on several factors, primarily location, access, and the particular opportunities provided by that facility. The Red River corridor, along New Mexico 38 between Questa and the Town of Red River (Questa Ranger

District), is easily accessible, very popular, and developed campgrounds are regularly filled to capacity. Conversely, the Agua Piedra Campground (Camino Real Ranger District) is in a highly desirable mountain setting with recreational vehicle camping, but is more remote, resulting in less visitation.

In addition to recreational vehicle camping, large group camping has become more important to many forest users and is a very popular form of recreating on the Carson. Campgrounds that provide large group camping facilities are in very high demand.

Motorized Recreation

Motorized recreation is popular across the Carson during the summer and fall. The Town of Red River draws a large number of visitors, who participate in motorized recreation activities during the summer months. In the fall hunting season, a significant increase in the use of off-highway vehicles occurs across the forest. Motor Vehicle Use Maps indicate where motor vehicle use is allowed on the forest.

The Carson provides snowmobile opportunities in the winter. Recent below normal snowfall and above normal temperatures in most of New Mexico have resulted in few places that have reliable snowpack for snowmobile use. Portions of the Tres Piedras, Questa, and Camino Real ranger districts are destinations for winter motorized recreation and usually have reliable snowpack even during dry years.

Maintenance of existing roads and motorized trails is a continuing issue for the forest. With decreasing budgets, only a small number of roads and motorized trails receive maintenance in any given year. This not only degrades the motorized experience through poorly maintained infrastructure, but it also impacts natural resources through soil erosion and increased sedimentation.

Some towns within the assessment area, particularly Red River, rely on the Carson for motorized tourism by supporting businesses that rent all-terrain vehicles to be used on the forest. Other communities, such as Angel Fire, are building a motorized tourism-based industry that would also rely on NFS lands.

Recreation Setting and Opportunities

Forest Service personnel use the recreation opportunity spectrum (USDA FS 1982) as a tool to manage for a spectrum of recreation opportunities that can be experienced in diverse settings. A recreation opportunity is the ability to participate in a specific recreation activity in a particular recreation setting. Recreation opportunities include non-motorized, motorized, developed, and dispersed recreation on land, on water, and in the air. The social, managerial, and physical attributes of a place, when combined, provide a distinct set of recreation opportunities. Opportunities vary along the spectrum from a very high probability of solitude, self-reliance, challenge, and risk (primitive) to very social opportunities where self-reliance, challenge, and risk are relatively unimportant to the experience (rural or urban). The physical setting is defined by the absence or presence of human sights and sounds, size, and the amount of environmental modification caused by human activity. The social setting reflects the amount and type of contact between individuals or groups. The recreation opportunity spectrum class setting characterizations are shown in table 57.

Recreation opportunity spectrum classes were assigned forestwide under the 1986 Forest Plan. Thus, the existing inventory does not appropriately identify which areas are currently providing which opportunities. An important aspect of the recreation opportunity spectrum is to ensure the Carson is providing a diversity of recreation settings and opportunities that respond to public desires and expectations.

Table 57. Recreation opportunity spectrum class setting characterizations

Class	Characterization
Primitive	Characterized by an essentially unmodified natural environment of fairly large size. Interaction between users is very low and evidence of other users is minimal. The area is managed to be essentially free of evidence of human-induced restrictions and controls. Motorized use within the area is not permitted. There are no developed facilities.
Semi-primitive non-motorized	Characterized by a predominantly natural or natural-appearing environment of moderate to large size. Interaction among users is low, but there is often evidence of other users. The area is managed in such a way that minimum on-site controls and restrictions may be present but would be subtle. Motorized recreation is not permitted, but local roads used for other resource management activities may be present on a limited basis. Use of such roads is restricted to minimize impacts on recreation experience opportunities. A minimum of developed facilities (if any) are provided.
Semi-primitive motorized	Characterized by a predominantly natural or natural-appearing environment of moderate to large size. Concentration of users is low, but there is often evidence of other users. The area is managed in such a way that minimum on-site controls and restrictions may be present but would be subtle. Motorized use of local primitive or collector roads with predominantly natural surfaces and trails suitable for motorbikes is permitted. Developed facilities are present but are more rustic in nature.
Roaded natural	Characterized by predominantly natural-appearing environments with moderate evidence of the sights and sounds of people. Such evidence usually harmonizes with the natural environment. Interaction among users may be moderate to high, with evidence of other users prevalent. Resource modification and utilization practices are evident but harmonize with the natural environment. Conventional motorized use is allowed and incorporated into construction standards and design of facilities, which are present and well defined.
Rural	Characterized by a substantially developed environment and a background with natural appearing elements. Moderate to high social encounters and interaction between users is typical. Renewable resource modification and utilization practices are used to enhance specific recreation activities. Sights and sounds of humans are predominant on the site and roads and motorized use is extensive. Facilities are more highly developed for user comfort with ample parking.
Urban	Characterized by a substantially urbanized environment, although the background may have natural-appearing elements. Renewable resource modification and utilization practices are to enhance specific recreation activities. Vegetative cover is often exotic and manicured. Sights and sounds of people on-site are predominant. Large numbers of users can be expected, both on-site and in nearby areas. Facilities for highly intensified motor use and parking are available with forms of mass transit often available to carry people throughout the site

Congressionally designated wilderness areas are often associated with a primitive type of recreation opportunity, but the primitive recreation opportunity spectrum class is not synonymous with designated wilderness. On the Carson NF, recreation opportunities in designated wilderness areas were not previously inventoried.

The assessment report identified a need to re-inventory recreational opportunities by recreation opportunity spectrum class and make future adjustments as necessary (USDA FS Carson NF 2015a). During the current plan revision effort an inventory of recreation opportunity spectrum existing condition was completed incorporating best available science and public input (USDA FS Carson NF 2018f). Table 58 displays the summer recreation opportunity spectrum classifications established under the 1986 Forest Plan compared to the updated inventory completed in 2018.

Table 58. Summer recreation opportunity spectrum for the Carson under the 1986 Forest Plan compared to the inventory completed in 2018

Summer Recreation Opportunity Spectrum Setting	1986 Forest Plan (acres)	NFS lands (percent)	2018 Inventory (acres)	NFS lands (percent)
Primitive	0	0	86,997	6
Semi-primitive non-motorized	219,222	15	616,309	41
Semi-primitive motorized	761,500	51	523,624	35
Roaded natural	487,669	33	257,258	17
Rural	2,195	Less than 1	3,874	Less than 1
Urban	1,728	Less than 1	2,059	Less than 1

During winter months, portions of the Carson NF receive sufficient snow that roads are not drivable but other snow- and ice-based recreation opportunities become available. Over-snow vehicle use is allowed except in areas that have been closed to cross-country snowmobile use (see figure 20) or overlap designated wilderness. Closure to cross-country access does not prohibit motorized use on open roads or motorized trails.

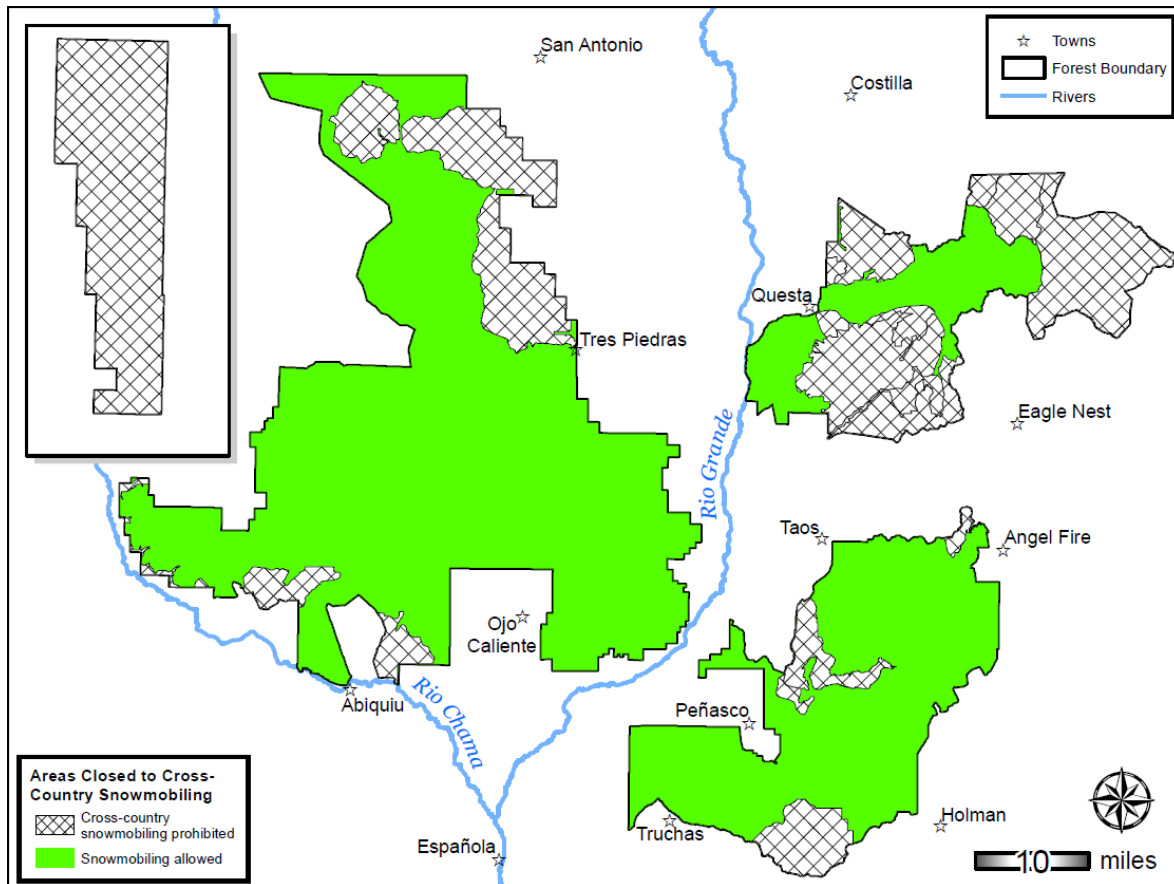


Figure 20. Areas closed to snowmobiles by the 1986 plan or the Valle Vidal Multiple Use Area Guide

Table 59. Winter recreation opportunity spectrum for the Carson under the 1986 Forest Plan compared to the inventory completed in 2018

Winter Recreation Opportunity Spectrum Setting	1986 Forest Plan (acres)	NFS lands (percent)	2018 Inventory (acres)	NFS lands (percent)
Primitive	0	0	83,997	6
Semi-primitive non-motorized	172,444	12	572,549	38
Semi-primitive motorized	820,349	55	571,123	38
Roaded natural	487,670	33	257,765	17
Rural	2,195	Less than 1	3,903	Less than 1
Urban	1,728	Less than 1	2,065	Less than 1

Recreation Issues and Trends

The recreation program on the Carson NF plays a key role in the social stability, environmental integrity, and economic vitality of the surrounding communities. A sustainable recreation program is integral in protecting the natural, cultural, and scenic environment for present and future generations to enjoy.

Several factors relating to societal, lifestyle, and demographic trends can affect recreation participation. Populations and demographics will change over time and new trends and demands will emerge from those changes. New Mexico's population has seen a 1.1 percent increase since 2010 (US CB 2016). New Mexico's population is projected to grow about 35 percent over the next 25 years (NM State Parks 2015). As population increases, visitor demographics and national forest visitor desires will likely become more diverse and expectations for recreation opportunities will change. These changing demographics will become increasingly more important in the management of recreation and scenic resources on the Carson NF.

Trail use continues to increase, resulting in ongoing challenges in the maintenance, construction, and reconstruction of trails. Additionally, unauthorized routes (created both by motorized and non-motorized users) are on the rise, resulting in resource damage.

Off-highway vehicle use has increased in popularity on public lands throughout the country, including the Carson NF. Travel management, per the 2005 Travel Management Rule, has been completed for the entire Forest and implementation should reduce motorized travel off the designated system.

Mountain biking is another recreation use that has increased in popularity since the 1986 Carson plan. The increase is most notable on the Questa and Camino Ranger Districts but is likely to increase on all ranger districts over the next few years.

Special use authorizations generate a significant amount of revenue for the Carson each year. The growing demand for these services may have greater implications on the general recreating public in the future.

Stand-replacing wildfire and insect and disease outbreaks have negatively impacted recreational settings and scenic character in recent years. Such events are becoming the norm in the Southwest and result in a marked contrast to natural-appearing landscapes.

Sustainable Recreation Strategy Action Plan

Since 2012, the Forest Service recreation program has focused on sustainable recreation—a Forest Service strategy for managing forest recreation programs to reflect current and future visitor needs, desires, and expectations. In 2016, the Carson, in accordance with Southwestern Regional Office direction, developed and adopted a Sustainable Recreation Strategy Action Plan (USDA FS Carson NF 2016). The purpose of the action plan is to provide direction for making the Carson's recreation program

more sustainable. This action plan includes 11 actions which include implementing a public engagement plan and a Carson volunteer plan, keeping the national forest website recreation pages up-to-date, developing responsibilities for managing the Carson dispersed recreation program using partners and volunteers, and reducing services or amenities, when needed, to keep developed recreation sites open for public use (USDA FS Carson NF 2016).

Environmental Consequences for Recreation

Methodology and Analysis Process

The recreation opportunity spectrum provides a framework for defining the types of motorized and non-motorized outdoor recreation opportunities the public might desire and identifies that portion of the spectrum a given national forest might be able to provide or sustain or both. The recreation opportunity spectrum provides the structure for describing the Carson's contribution to sustainable flows of recreation settings, and visitor opportunities. The recreation opportunity spectrum is used to describe whether management actions would sustain classes and related opportunities, change classes and related opportunities, or both.

Carson National Forest personnel have a responsibility to provide resilient and relevant recreational opportunities representing a spectrum of recreation opportunities for current and future generations. Recreational users of the Carson are diverse and have varying opinions and desires for a sustainable recreation program across the forest. Under each of the following proposed alternatives, the Carson National Forest would move forward, "to unite diverse interests, create and strengthen partnerships, focus scarce resources on mission-driven priorities, connect recreation benefits to communities, provide for changing urban populations, and most importantly, sustain and expand the benefits to America that quality recreation opportunities provide" (USDA FS 2010a).

Each proposed alternative below addresses the core themes and attempts to resolve significant recreation issues identified by the public.

Indicators and Measures

- Acres assigned to each recreation opportunity spectrum class. This indicator reflects changes to recreation settings due to anticipated management activities associated with each alternative. It reflects the relative balance between motorized and non-motorized recreation settings that can be anticipated under each alternative.

Assumptions

In the analysis for this resource, the following assumptions were made:

- All alternatives provide for a variety of motorized and non-motorized recreational settings and opportunities.
- The framework for recreation opportunity spectrum characteristics and sustainable recreation will be applied in project-level planning for all Carson National Forest activities.
- The analysis assumes that visitors want varying experiences, from primitive to highly developed, to be available but that the Forest Service cannot accommodate all preferences in all parts of the national forest.
- Motorized vehicle use will continue to be designated and managed in accordance with the Travel Management Rule, 36 CFR parts 212, 251, 261 and 295.

- Recreation opportunity spectrum settings are based on the physical, social, and managerial setting characteristics (FSM 2310). Desired recreation opportunity spectrum settings result from interdisciplinary discussions, public engagement, and the NEPA process. The amount of vegetation manipulation can have a large impact on recreation opportunity spectrum settings and is an objective way to look at whether management is meeting desired recreation opportunity spectrum.
- Visitor use information specific to each district is not available. National visitor use monitoring information is collected for the entire Carson National Forest. Site-specific and recreation-opportunity-spectrum-related use data are not available.
- Forest plan decisions do not affect visitation rates on the Carson; however, new or altered management direction may influence the type of opportunities that are available to the public.

Environmental Consequences for Recreation

Environmental Consequences for Recreation Common to All Alternatives

All alternatives provide a framework for managing recreation through standards and guidelines in a plan. Land management activities directed by the plan have the potential to impact recreation opportunities and settings under all alternatives. Recreation resources are affected when management activities or proposed projects alter the recreation setting or related opportunities.

Standards and guidelines in all alternatives would allow for thinning and burning activities to be used to accomplish project or plan level desired conditions. In forested vegetation communities thinning and burning would reduce tree density and would change recreation opportunities available to Carson visitors. The provision of less-densely vegetated forest lands would provide more opportunities for certain recreation activities. Dispersed camping, picnicking, wildflower and wildlife viewing, travel by foot, horseback, skis, bicycles, or motorized vehicles, and some types of hunting (e.g., for elk) would all benefit from more open forest areas (Englin et al. 2001; Venn and Calkin 2011). Vegetative desired conditions for more open forests would be less appealing to some campers who may avoid dispersed sites with less vegetative screening. On the other hand, more open park-like areas would be more visually appealing and actually aid in accessing dispersed camping sites for some visitors (e.g., visitors pulling large trailers or driving recreational vehicles). User-created trails for bicycling, horseback riding, and hiking may be more likely in areas opened by fuel treatments or uncharacteristic large disturbances. Frequent and extensive vegetation treatments that elicit formal closures or cause recreationists to avoid these sites would be frustrating to users and negatively impact their recreation experiences on the Carson.

Thinning and burning activities that change scenery in forested vegetation communities would also affect recreationists' experiences. Some recreationists would avoid treated areas with views of freshly cut stumps, vegetation piles, and blackened and burned vegetation. Loss of screening vegetation or forest canopy that provides shading along trails or at dispersed camping sites would also negatively impact recreation use.

Vegetation treatments in all alternatives (i.e., thinning and burning) have the potential to alter recreation opportunity spectrum classes from those that are predominantly natural-appearing (i.e., primitive, semi-primitive non-motorized, semi-primitive motorized, and roaded natural) to those with more modified environments (i.e., rural or urban). Mechanical thinning and prescribed burning actions could be consistent with managing for predominantly natural-appearing environments of primitive, semi-primitive non-motorized, semi-primitive motorized, and roaded natural recreation opportunity spectrum classes, even though they would be visually evident. However, these treatments could result in more open environments and changes in recreation opportunities by increasing the evidence of other users, which may not be consistent with semi-primitive non-motorized, semi-primitive motorized recreation opportunity spectrum classes. In contrast, primitive recreation opportunity spectrum classes would not

have similar effects because most of the primitive areas are in wilderness where mechanical thinning could not occur or are in less popular parts of the forest where the chance of encountering other users is always low. In addition, fires that are uncharacteristically large and burn with more severe intensity could have effects that occur over larger areas and last longer and are thereby inconsistent with managing for predominantly natural-appearing recreation opportunity spectrum classes. Any minor inconsistencies in managing for recreation opportunity spectrum settings would persist until the evidence of modification practices (e.g., stumps) are not evident and vegetative desired conditions are restored. Effects from uncharacteristic wildfires can be long-lasting and would take longer periods to revert back to the desired recreation opportunity spectrum setting.

Roads provide recreationists with access to the forest and can affect the recreation opportunity spectrum settings and opportunities. All alternatives include road objectives for decommissioning, maintaining, or constructing roads. More and better-maintained roads would increase access throughout the forest and expand dispersed recreation opportunities. Road decommissioning, would improve fish and wildlife habitat, increasing the quality and quantity of opportunities for wildlife watchers, fishers, and hunters to participate in those activities. Recreationists striving for solitude would also benefit from areas at greater distances from roads from reduced road density. However, some of these increased non-motorized opportunities would also increase the potential for actions that would be prohibited or discouraged, such as motorized use off of designated roads or camping further than allowed from those roads, leading to damage or disturbance to other forest resources (e.g., water, soil, wildlife, sensitive plants) (Lavery et al. 2000).

Oil and gas development and production currently occurs on the forest within the Jicarilla Natural Gas Management Area. The effects of these developments can have short- and long-term consequences that could include degraded recreational experiences because of scenic impacts, noise, and mining activity.

Designated areas and eligible wild and scenic rivers are consistent across all alternatives. Management direction is often dictated by law, regulation, and policy. Some designated areas have a recreation focus, and some emphasize specific types of recreation opportunities. Wilderness areas allow visitors to connect with nature and experience solitude and primitive and unconfined recreation. Designated and eligible Wild and Scenic Rivers, especially those with recreation as an outstandingly remarkable value, provide opportunities for recreation on or near free-flowing rivers. National recreation, scenic, and historic trails offer opportunities for exceptional trail experiences. Together, and in concert with recreation opportunities on the rest of the forest, these designated areas expand recreation opportunities and their effects. Proposed research natural areas restrict the types of and options for recreational use.

The Carson is divided into recreation opportunity spectrum classes ranging from primitive to urban. A map of the desired recreation opportunity spectrum classes is in plan appendix A (figure A-1). Table 60 through table 67 display the acres of desired recreation opportunity spectrum under each alternative. Summer recreation opportunities differ from winter recreation opportunities based on decisions that the Carson NF has made about where over-snow vehicles are allowed and the recommended wilderness management area locations under each alternative. Recreation opportunity settings that are non-motorized during the summer but where snowmobiling is allowed are considered semi-primitive motorized during the winter.

Environmental Consequences for Recreation – Alternative 1

Under alternative 1 (no-action alternative), the existing plan would remain in effect. Carson NF personnel would continue to use the recreation opportunity spectrum outlined in the existing condition and as defined in table 60, and current management practices would continue as they are outlined in the 1986 Forest Plan.

Table 60. Current plan recreation opportunity spectrum acres by class

Recreation Opportunity Spectrum Setting	1986 Forest Plan - summer (acres)	Percent of Carson NF	1986 Forest Plan - winter (acres)	Percent of Carson NF
Primitive ¹⁸	0	0	0	0
Semi-primitive non-motorized	219,222	14	172,444	12
Semi-primitive motorized	761,500	48	820,349	55
Roaded natural	487,669	31	487,670	33
Rural	2,195	Less than 1	2,195	Less than 1
Urban	1,728	Less than 1	1,728	Less than 1
Undetermined	3,788	Less than 1	3,788	Less than 1

More than three-quarters of the Carson NF would remain in the semi-primitive motorized and roaded natural classes, and approximately 14 percent would remain in the semi-primitive non-motorized class. Most designated wilderness would not be assigned a recreation opportunity spectrum class. During the winter, most non-wilderness areas would be classified as some form of motorized setting. These settings would continue to provide opportunities for visitors to see and enjoy a variety of experiences on the national forest.

All current management areas and designated areas would continue to exist as they are described in the plan. All 21 management areas would continue to provide different user opportunities through distinct management emphases. However, this alternative would not provide recreation opportunities that are consistent with the social, environmental, and economic resource capacity of the Carson as required by the 2012 Planning Rule because many more motorized opportunities would need to be provided and maintained.

It may be challenging for recreation managers to provide a sustainable recreation program now and into the future by referencing a document created in the mid-1980s. Recreation trend data and visitor use have changed dramatically over time, and issues, opportunities, and expectations are different.

Recreation management would continue to provide dispersed and developed recreation opportunities and would enhance experiences by providing access, services, and facilities with other resource considerations. There would continue to be an emphasis on dispersed recreation and less of an emphasis on developed recreation.

Under current plan management, many non-motorized and motorized trails do not provide the diversity of recreational experiences that many local users and visitors desire. Under current plan management many of the developed recreation sites are not designed or developed to provide the recreation experience current users desire. Alternative 1 does not adequately consider the recreation experience the public desires to provide opportunities that will be best utilized and improve the forest’s contribution to the economy. Not providing the recreation opportunities and experiences that are important to the public may result in decreased visitor use, which could result in a loss of economic opportunity for communities and businesses around the forest.

The 1986 Forest Plan addresses conflicting uses with two standards that direct separating or otherwise resolving conflicts among recreation uses that may adversely affect one another. This plan direction ensures that conflicting uses are addressed and that conflicting uses should not co-occur, thereby

¹⁸ Designated wilderness is not assigned a recreation opportunity spectrum classification in the current inventory. Percentages do not equal 100.

benefitting recreation. Potential solutions for separating recreation uses could involve single-use trails or trails managed for single use on certain days. Creating more trails would likely require more recreation infrastructure such as trailheads and signage and could cause more ecological damage to soil, wildlife, water, and cultural resources. Managing trails for single uses that vary by day of the week would require increasing public awareness and could cause more user conflicts and lower the quality of the recreation experience if recreationists did not follow the rules. Solutions to the satisfaction of all users are rare, and they can require extensive management resources.

With most designated wilderness not being assigned a recreation opportunity classification; the plan may be more difficult to comprehend. This leads to confusion regarding management expectations. There is no recommended wilderness in this alternative.

For all other recreation-specific management standards and guidelines, reference the 1986 Forest Plan (USDA FS Carson NF 1986). For a more in-depth discussion on wilderness and other designated areas, please reference the “Designated Areas” section of this environmental impact statement.

Environmental Consequences for Recreation Common to Alternatives 2, 3, 4, and 5

Recreation and recreation-related activities were identified as being the greatest contributor to the economy for communities and business around the forest. The Carson provides and manages many recreation opportunities and experiences important for attracting visitors to the region. All action alternatives recognize the importance of maintaining and improving this resource by providing guidance and direction to develop recreation activities and experiences that are important for the visiting public and appropriate within the recreation opportunity spectrum. The Carson is important for winter activities such as downhill skiing, cross country skiing, snowshoeing, snowmobiling, ice fishing, and hunting. The Carson is just as important for summer activities such as camping, hiking, fishing, wildlife viewing, off-highway vehicle riding, and mountain biking. Direction and guidance found within all alternatives would provide management that focuses on partnership and community involvement that would move toward high quality developed and dispersed recreation opportunities and provide a diversity of user activities and experiences. Recreation activities and experiences desired by partners, communities, and forest users would attract more visitors who seek out these opportunities, which potentially would contribute more to the social and economic vibrancy of local communities and businesses. The communities around the forest provide restaurants, hotels, shopping, and other business which would benefit from increased recreational activity. Local users would gain increased outdoor recreation opportunity that would have health benefits.

Alternatives 2, 3, 4, and 5 would adopt desired recreation opportunity spectrum classes for the Carson NF and the guidance for project-specific analysis and implementation would be referenced by the recreation opportunity spectrum guidebook and in plan components. Decisions related to recreation settings and related physical and social components would be consistent with desired recreation opportunity spectrum classes.

Under all action alternatives, the revised plan would contain components in the form of desired conditions, objectives, standards, and guidelines to better address or align with the framework for sustainable recreation. These components would also assist the forest in moving toward the management of a sustainable recreation program and would allow for a better response to current recreation activities and better adaptation to current and future demands for recreation.

The recognition of the role of partnerships under these alternatives would serve to increase the capacity for education about user conflicts and solutions, including awareness of impacts on other uses. Ultimately, partnerships could be one way to overcome the challenges of addressing user conflicts that exist under Alternative 1.

Implementation of the action alternatives would likely have similar impacts on recreation, with the exception of differences related to recommended wilderness, differences associated with levels of prescribed burning and mechanical treatment, and differing management areas. These differences will be discussed by action alternative below.

Mountain biking opportunity would be reduced according to the number of acres in the recommended wilderness management area across each alternative. Mountain bikers may be displaced from areas that were once open to mechanized recreation but would be managed as recommended wilderness management areas.

Under all action alternatives, the Developed Winter and Summer Resort Management Area comprises the four permitted ski areas on the Carson. This management area is currently managed with special use permits and would continue to be under all alternatives. This management area would continue to provide the majority of the Carson's winter recreational opportunities and some developed summer recreational opportunities. The substantive difference among action alternatives for the Developed Winter and Summer Resort Management Area occurs in alternative 3. Under alternative 3, the management area is expanded by 921 acres around the Sipapu Ski and Summer Resort. The current Sipapu permitted boundary is 215 acres and would remain this acreage under all alternatives except alternative 3 where it would likely be expanded through a separate analysis. The effect of this change is discussed in Environmental Consequences – Alternative 3.

Climate change may negatively impact recreation opportunities in the future. Maintaining ecosystem resistance and resiliency may help mitigate some potential negative impacts of climate change to the recreation opportunities on the Carson. These effects may include increased visitation across multiple recreation sites due to longer shoulder seasons; reduced snow fall in November and December means more opportunities for non-snow-based recreation during the extended season. This could mean a greater need for recreation management and facility maintenance.

On the other hand, climate change may also impact recreation in the opposite way. Severe fire or other implications due to a hotter, drier summer climate may close recreation facilities for an extended period of time, thus limiting the recreation opportunities available in affected areas. Some other effects may be an increase in negative impacts to sensitive and limited resources such as water, or plant and animal communities. This could make it more difficult to manage the impacts to these resources along with managing increased public use. The analysis of impacts for alternatives 2, 3, 4, and 5 below all address the potential impacts of climate change.

Environmental Consequences for Recreation – Alternative 2

This alternative would create a change in recreation opportunity spectrum settings. The proposed action recommends 9,189 acres (table 36) for wilderness designation. This action also classifies all designated and recommended wilderness into either the primitive or semi-primitive non-motorized recreation opportunity spectrum classes. Other recreation opportunity spectrum classes, such as the semi-primitive motorized and roaded natural classes would be reduced. For over-snow recreation there would be about three times as much semi-primitive non-motorized opportunity, less semi-primitive motorized opportunity, and about half as much roaded natural opportunity compared to alternative 1.

Under alternative 2, management of recreation would be guided by desired recreation opportunity spectrum classes for all the Carson NF (table 61).

Table 61. Summer desired recreation opportunity spectrum setting by acres for alternative 2 compared to alternative 1 – no-action

Summer Recreation Opportunity Spectrum Setting	Alternative 1 1986 Forest Plan (acres)	Alternative 2 (acres)	Alternative 2 area on the Carson (percent)
Primitive	0	93,326	6%
Semi-primitive non-motorized	219,222	367,310	23%
Semi-primitive motorized	761,500	714,800	45%
Roaded natural	487,669	308,647	19%
Rural	2,195	586	Less than 1%
Urban	1,728	1,807	Less than 1%
Undetermined	3,788	3,788	Less than 1%

Table 62. Winter existing recreation opportunity spectrum setting by acres for alternative 2 compared to alternative 1 – no-action

Winter Recreation Opportunity Spectrum Setting	Alternative 1 1986 Forest Plan (acres)	Alternative 2 (acres)	Alternative 2 area on the Carson (percent)
Primitive	0	84,138	6%
Semi-primitive non-motorized	172,444	574,475	39%
Semi-primitive motorized	820,349	569,056	38%
Roaded natural	487,670	257,765	17%
Rural	2,195	3,903	Less than 1%
Urban	1,728	2,065	Less than 1%
Undetermined	3,788	0	0%

In alternative 2, recreation and transportation plan objectives direct completion of: FW-REC-O-5 Rehabilitate 5 to 7 areas where dispersed camping. is causing unacceptable erosion, during each 10-year period of the plan; FW-TFA-O-3 Maintain at least 100 to 300 miles of trails (including motorized) annually; and FW-TFA-O-4 Maintain at least 10-20 percent of recreation signage, during each 5-year period of the plan. There is also a guideline that directs closing, rehabilitating, or mitigating dispersed campsites that are not meeting scenic integrity objectives, or are causing ecological damage. This plan guidance offers more specific direction to maintain developed and dispersed recreation infrastructure on the Carson. Recreation plan components under this alternative align with sustainable recreation practices and provide for a range of high-quality recreation settings which would allow for collaboration and community involvement as well as education and interpretative programs.

Under this alternative there are objectives that would increase the current rate of mechanical treatment (27,500 to 60,000 acres during each 10-year period) and the current rate of wildland fire (100,000 to 165,000 acres during each 10-year period). The level of thinning and burning proposed with alternative 2 and the associated effects discussed under effects on recreation common to all alternatives would be the second highest among all alternatives. The likelihood of stand-replacing wildfire and its effects on recreation opportunities would be diminished in areas mechanically thinned, and overall, as a guideline directs suppression when lightning strikes start fire outside the range of natural variability or when necessary to protect life, investments, and valuable resources.

Plan direction in alternative 2 would result in obliterating non-system roads. This activity could have a minor effect on overall recreation experience as some walkers may enjoy some of these routes. It could improve the recreation experience for hikers and walkers by decreasing use on unauthorized routes. Plan

direction calls for maintaining 100 to 300 miles of motorized and non-motorized trails annually. This includes signage as well as the condition of trails. This maintenance would make trail use safer and improve recreation experience.

Alternative 2 has three placed-based management areas, grassland maintenance management area (all ranger districts), Valle Vidal Management Area (Questa Ranger District), and San Antonio Management Area (Tres Piedras Ranger District), each having their own set of plan components. grassland maintenance management area (MA-GMMA-DC-1) preserves woodlands and ponderosa pine forest in a treeless state to promote forage production. Preserving woodlands and ponderosa pine forest in a treeless state has the potential to alter recreation opportunity spectrum classes from those that are predominantly natural-appearing (i.e., primitive, semi-primitive non-motorized, semi-primitive motorized, roaded natural) to those with more modified environments (i.e., rural or urban). More open environments could also change recreation opportunities by increasing the evidence of other users which may not be consistent with semi-primitive non-motorized and semi-primitive motorized recreation opportunity spectrum classes.

Valle Vidal Management Area (MA-VVMA-DC 1, 2, 4, and 5) and San Antonio Management Area (MA-SAMA-DC 1, 3, and 4) are managed for multiple uses, focusing on the restoration and protection of diverse, resilient, biological communities for future generations, while providing a quality backcountry outdoor recreation experience. Valle Vidal and San Antonio Management Areas limit development and road construction. These management areas would increase recreation opportunity spectrum classes that are predominantly natural-appearing (i.e., p, semi-primitive non-motorized, and semi-primitive motorized).

Environmental Consequences for Recreation – Alternative 3

Alternative 3 has plan guidance that places the greatest emphasis on increasing more developed recreation opportunities. These management actions suggested in alternative 3 would create a change in recreation opportunity spectrum settings (table 63).

This alternative includes guidelines and objectives to convert temporary and non-system roads into motorized and non-motorized trails, to develop mountain bike trail systems, and to convert a percentage of existing campsites in 5 campgrounds from single use to multiple use sites within 10 years. These guidelines and objectives would increase the amount and type of recreation opportunities offered across the Carson. However, existing roads are often not good options for creating sustainable trails, and trails on converted roads may cause more negative environmental impacts and require more costly and frequent maintenance than purpose-built trails. Converting a percentage of existing campsites in five campgrounds from single-use to multiple-use sites within 10 years would move the forest closer to meeting the camping recreation experience important to many forest users.

Alternative 3 does not include objectives for road decommissioning but does include an objective to maintain 150 miles of road a year and a guideline that would allow for the expansion of the road system through the inclusion of temporary roads. It also includes off-highway vehicle management area. This management area includes a desired condition that emphasizes cross-country travel opportunities to provide challenging terrain for trials motorcycles and off-highway vehicle rock crawling. It also includes a standard that prohibits non-motorized trails within this management area. These plan components and proposed management area represent the largest potential road system (i.e., road miles) and greatest number of road miles maintained of any alternative which would increase opportunities for motorized recreation but decrease opportunities for non-motorized recreation. More roads, as provided in this alternative, would also move away from the beneficial effects on recreation opportunities achieved by decommissioning unneeded roads.

Table 63. Summer desired recreation opportunity spectrum setting acres for alternative 3 compared to alternative 1 – no-action

Summer Recreation Opportunity Spectrum Setting	Alternative 1 1986 Forest Plan (acres)	Alternative 3 (acres)	Alternative 3 area on the Carson (percent)
Primitive	0	91,124	6%
Semi-primitive non-motorized	219,222	367,859	23%
Semi-primitive motorized	761,500	719,493	45%
Roaded natural	487,669	309,395	19%
Rural	2,195	586	Less than 1%
Urban	1,728	1,807	Less than 1%
Undetermined	3,788	0	0

Table 64. Winter existing recreation opportunity spectrum setting by acres for alternative 3 compared to alternative 1 – no-action

Winter Recreation Opportunity Spectrum Setting	Alternative 1 1986 Forest Plan (acres)	Alternative 3 (acres)	Alternative 3 area on the Carson (percent)
Primitive	0	83,997	6%
Semi-primitive non-motorized	172,444	572,549	38%
Semi-primitive motorized	820,349	571,123	38%
Roaded natural	487,670	257,765	17%
Rural	2,195	3,903	Less than 1%
Urban	1,728	2,065	Less than 1%
Undetermined	3,788	0	0

Under this alternative, there are objectives that would increase the current rate of mechanical treatment (75,000 to 130,000 acres during each 10-year period) and maintain the same rate of wildland fire (100,000 to 165,000 acres during each 10-year period) as in alternative 2. The level of thinning and burning proposed under alternative 3 and the associated effects discussed under effects common to all alternatives on recreation opportunities would be the greatest among all alternatives. The likelihood of stand-replacing wildfire and its effects on recreation opportunities would be diminished in areas mechanically thinned, and overall, as a guideline directs suppression when lightning strikes start fire outside the range of natural variability or when necessary to protect life, investments, and valuable resources.

There are no acres of recommended wilderness in this alternative. The Valle Vidal and San Antonio Management Areas are not included in this alternative. Alternative 3 proposes the Grassland Maintenance Management Area (all ranger districts). Effects to recreation from the Grassland Maintenance Management Area would be the same as discussed in alternative 2.

Under alternative 3, the developed winter and summer resort management area is expanded by 921 acres around the Sipapu Ski and Summer Resort. Expansion of the permit boundary for the Sipapu Resort would be completed through a separate analysis. The current Sipapu permitted boundary is 215 acres and would not be changed by any alternatives. Expanding this management area would provide the potential to increase winter recreation opportunities and increase visitation on the Camino Real Ranger District. Increased visitors could increase tourism income to the local area through more use of local hotels, restaurants, and shops.

Alternative 3 would increase the availability of motorized and non-motorized recreation opportunities and their related effects more than other alternatives.

Environmental Consequences for Recreation – Alternative 4

Alternative 4 emphasizes backcountry and primitive recreation by decreasing the intensity of restoration treatments using mechanical means and allowing a natural process to occur including managing naturally occurring fires. The intent of this alternative is to provide more solitude, remoteness, and primitive recreation, with more emphasis on dispersed recreation than developed recreation. This would be achieved with a standard that prohibits cross-country over-snow motorized use and an objective to decommission unneeded roads. This alternative would limit opportunities for additional motorized recreation. This would minimize the impacts from motorized recreation and improve the ability to manage for sustainable recreation the most of all alternatives. However, limiting motorized use opportunities could increase unauthorized use on closed roads and increase ground-disturbing effects from this use.

Alternative 4 has several management areas (Rio Grande cutthroat trout, Wetland Jewels, San Antonio, and Valle Vidal) that place an emphasis on managing for natural processes and would decrease developed recreation and emphasize dispersed, non-motorized recreation. Valle Vidal and San Antonio Management Areas in this alternative include standards and guideline that promote primitive and semi-primitive non-motorized recreation opportunities more than alternative 2. However, these management areas would also have less motorized use and would provide more non-motorized recreation experiences such as hiking, dispersed camping, and other similar activities. Valle Vidal and San Antonio Management Areas would prohibit motorized trails in this alternative. For Valle Vidal, prohibiting motorized trail would not limit recreation experiences as this area is already managed for more non-motorized recreation experiences. The Valle Vidal is unique on the Carson NF in that it has been managed since its acquisition according to the Multiple Use Guide, which directs that new road or motorized trail construction be minimized. By prohibiting motorized trails in San Antonio, future motorized recreation opportunities may be limited, which could increase unauthorized use on closed roads and increase ground-disturbing effects from this use.

This alternative also extends the San Antonio Management Area onto the east side of the Carson called Cebolla Mesa (see FEIS Volume 3 Appendix B) and includes timing restrictions to prohibit public entry for winter range. This extension would change how the Cebolla Mesa is managed recreationally. This area has high motorized use and has a current ROS class of semi-primitive motorized, and limiting motorized use would limit motorized recreation opportunities. Also, the timing restriction would limit fishing use along the Rio Grande in the Cebolla Mesa area, which is a high-use winter fishing area.

Developed Winter and Summer Resort Management Area is the same as described in alternative 2, and the effects from this management area on recreation would be the same as described in alternative 2.

In alternative 4, there are no objectives for mechanical treatment, but the prescribed fire objective would increase the current rate of prescribed burning to 125,000 to 205,000 acres during each 10-year period. This level of burning and its associated effects on recreation opportunities is the highest of all alternatives. The likelihood of stand-replacing wildfire and its effect on recreation opportunities would be greater in this alternative because areas with high fuel loads would not be thinned prior to the introduction of fire.

This alternative has recommended wilderness areas totaling 45,473 acres. Recommended wilderness would create a more primitive recreation opportunity for visitors, such as non-motorized trails and minimizing future development of developed recreation sites. Primitive means of recreation such as hiking, horseback riding, and hunting are emphasized and motorized access for recreation is limited and not expanded under this alternative.

Alternative 4 would create the greatest change in desired recreation opportunity spectrum settings from alternative 1 (table 65).

Table 65. Summer desired recreation opportunity spectrum setting by acres for alternative 4 compared to alternative 1 – no-action

Summer Recreation Opportunity Spectrum Setting	Alternative 1 1986 Forest Plan (acres)	Alternative 4 (acres)	Alternative 4 area on the Carson (percent)
Primitive	0	94,936	6%
Semi-primitive non-motorized	219,222	376,021	24%
Semi-primitive motorized	761,500	710,508	45%
Roaded natural	487,669	306,406	19%
Rural	2,195	586	Less than 1%
Urban	1,728	1,807	Less than 1%
Undetermined	3,788	0	0

Table 66. Winter existing recreation opportunity spectrum setting by acres for alternative 4 compared to alternative 1 – no-action

Winter Recreation Opportunity Spectrum Setting	Alternative 1 1986 Forest Plan (acres)	Alternative 4 (acres)	Alternative 4 area on the Carson (percent)
Primitive	0	84,306	6%
Semi-primitive non-motorized	172,444	592,498	38%
Semi-primitive motorized	820,349	550,865	37%
Roaded natural	487,670	257,765	17%
Rural	2,195	3,903	Less than 1%
Urban	1,728	2,065	Less than 1%
Undetermined	3,788	0	0

Environmental Consequences for Recreation – Alternative 5

Alternative 5 is the same as alternative 2 with the exception that it has all 13 areas or 67,996 acres with wilderness characteristics included as recommended wilderness. Recommended wilderness that would otherwise be motorized is instead converted into the primitive or semi-primitive non-motorized recreation opportunity spectrum classes. This action subsequently decreases the other recreation opportunity spectrum classes, such as the semi-primitive motorized and roaded natural classes (table 67).

Table 67. Summer desired recreation opportunity spectrum setting by acres for alternative 5 compared to alternative 1 – no-action

Summer Recreation Opportunity Spectrum Setting	Alternative 1 1986 Forest Plan (acres)	Alternative 5 (acres)	Alternative 5 area on the Carson (percent)
Primitive	0	93,476	6
Semi-primitive non-motorized	219,222	373,597	24
Semi-primitive motorized	761,500	710,999	45
Roaded natural	487,669	306,009	19
Rural	2,195	586	Less than 1
Urban	1,728	1,807	Less than 1
Undetermined	3,788	3,788	Less than 1

Table 68. Winter existing recreation opportunity spectrum setting by acres for alternative 5 compared to alternative 1 – no-action

Winter Recreation Opportunity Spectrum Setting	Alternative 1 1986 Forest Plan (acres)	Alternative 5 (acres)	Alternative 5 area on the Carson (percent)
Primitive	0	86,239	6%
Semi-primitive non-motorized	172,444	603,071	40%
Semi-primitive motorized	820,349	538,359	36%
Roaded natural	487,670	257,765	17%
Rural	2,195	3,903	Less than 1%
Urban	1,728	2,065	Less than 1%
Undetermined	3,788	0	0

Cumulative Environmental Consequences for Recreation (Dispersed and Developed)

The discussion of cumulative effects of the alternatives presented in this document examines how social and land use trends on public, State, Tribal, and private lands together influence the management of the Carson National Forest. These public lands provide a wide range of recreation opportunities in addition to the Carson, however, some major differences in agency missions and goals exist and can often result in different types of recreation experiences at each of those locations.

Management actions on adjacent lands may provide some of the same benefits that the actions proposed in these five alternatives would provide. Most state and local land managers conduct similar assessments to determine the impacts to all resources involved in project planning. The New Mexico Statewide Comprehensive Outdoor Recreation Plan (NM State Parks 2015) discusses goals of managing recreation through commitment to stewardship and the preservation of natural beauty and conservation of resources. Several lead organizations have outlined objectives for obtaining this goal across the state. If Federal, State, and local land managers work together in promoting and managing recreation across the state, the land within, and adjacent to, the Carson NF will not be negatively impacted at a compounded rate.

Within the planning period (the next 10 to 15 years), regional population growth—as well as growth and demand for a variety of recreation settings and opportunities—is expected to increase. A growing human population places increasing demands on recreation that could result in more visitor concentration and use at existing recreation areas, increased conflicts, increased density in motor vehicle use, and reduced quality of recreation settings. User controls may be needed in areas that become overcrowded to protect the health of the natural ecosystems and maintain an acceptable recreation setting for the public.

The increased use of off-highway vehicles may result in more conflict between motorized and non-motorized user groups throughout the cumulative effects analysis area. As use increases, compliance with regulations could become a greater challenge as recreational participants increase and compete for limited or popular space and resources. Primitive and semi-primitive non-motorized settings can be more vulnerable to increased visitation and use conflicts.

Climate variations over time have led to longer shoulder seasons in the region. Climatic changes may negatively impact some recreational opportunities due to hotter summers and shorter winters. This can create a busier shoulder season and potentially new and emerging recreational activities appearing in new locations and at unusual times of the year. With hotter and dryer summers, there is an increase for potentially devastating wildland fires. This could mean fire closure orders at multiple recreation sites, wilderness areas, trails, and other day-use facilities across the Carson, which would then negatively impact visitors.

The steady increase of hot and dry summers adds strain on already limited resources such as water. The demand for these valuable resources will continue to increase and protection measures will be extremely important now and into the future. Managers need to be cognizant of changing climate patterns and the effects they may have on future recreation trends and resources.

The last five years have shown a decrease in the overall recreation program budget, and it is likely that trend will continue into the future. Support for recreation staff, law enforcement, and facilities could see a decrease in some areas, and higher-use areas may need to be prioritized. The backlog of deferred maintenance may stay the same or increase over the years due to declining budgets. This will have a significant effect on visitors and recreation managers of the Carson National Forest. Land management agencies will continue to provide a variety of recreation opportunities throughout the region; however, they may not be able to meet the demand for every activity desired. Focusing on a sustainable recreation program which can accommodate the decreased budgets would be the best option for a successful recreation program on the Carson.

Recreation Summary

With the exception of alternative 1, the no-action alternative, the desired recreation opportunity spectrum settings would shift under all alternatives. Alternative 2 recommends 9,189 additional acres of wilderness. Alternative 3 is the human uses alternative where the management concentration is on providing motorized access and increased recreation opportunities. Alternative 3 does not recommend any wilderness. Alternative 4 proposes a less intensive approach to mechanical treatment and adds 45,473 acres of recommended wilderness and management areas with a desired primitive or semi-primitive non-motorized recreation opportunity spectrum class. With this action, there would be more primitive recreation opportunities and a concentration on the dispersed recreation setting as opposed to the developed. As a result, across all action alternatives, there would be more opportunities for primitive, unconfined recreation consistent with recommended wilderness and semi-primitive non-motorized opportunities in areas where road construction and motorized access are limited. Alternatives 4 and 5 would have the greatest shift toward these non-motorized settings.

Table 69. Comparison of recreation resource indicators by alternative

Indicator	Alternative 1 (acres)	Alternative 2 (acres)	Alternative 3 (acres)	Alternative 4 (acres)	Alternative 5 (acres)
Proposed Recommended Wilderness	0	9,189	0	45,473	67,996
Primitive settings	0	93,326	91,124	94,936	93,476
Semi-primitive non-motorized settings	219,222	367,310	367,859	376,021	373,597
Semi-primitive motorized	761,500	714,800	719,493	710,508	710,999
Roaded natural settings	487,669	308,647	309,395	306,406	306,009
Rural settings	2,195	586	586	586	586
Urban setting	1,728	1,807	1,807	1,807	1,807
Undetermined	3,788	3,788	0	0	3,788

Under all alternatives, integration, collaboration, and active engagement with communities are essential components of creating long-term sustainable recreation programs. The importance of community stewardship and partnerships will grow increasingly important over the life of the plan, requiring agencies at all levels to share resources and increase collaborative efforts regarding sustainable resource management. Funding across all local, State, and Federal governments is limited for construction and renovation of facilities, operations and maintenance, planning and monitoring, and staffing programs.

These budget limitations are presenting challenges to all land managers as they attempt to continue providing recreation for a growing and changing population. Securing adequate funding to maintain, construct, or reconstruct recreation facilities and trails to meet the needs of a growing population will be a challenge under all alternatives.

Recreation opportunity is “the availability of a real choice for a user to participate in a preferred activity within a preferred setting, to realize those satisfying experiences which are desired” (USDA FS Carson NF 1986). Having a diverse range of opportunities available for visitors to the Carson NF is a goal continued throughout each alternative. Carson National Forest personnel will work to create opportunities that are resilient and relevant for current and future generations; foster social and economic opportunities; and sustain the health, diversity, and productivity of the land to provide for a sustainable future.

Scenery

Description of Affected Environment

Some of the finest mountain scenery in the Southwest is found across the Carson. Elevations rise from 6,000 to 13,161 feet at Wheeler Peak, the highest peak in New Mexico. The forest offers breathtaking views of far off mountains, valleys below, and unsurpassed sunsets from almost every elevation. Green forests with lingering mountain meadows, streams, colorful wildflowers, and vibrant fall colors are peppered throughout the Carson’s broad landscape. The forest also offers open landscapes full of desert vegetation and beautiful canyon backdrops rich in colorful clays. At night, the stars are unhindered by urban lights and provide a spectacular light show.

The scenic characteristics of the forest are important for setting the sense of place that the Carson offers local people and visitors alike. They contribute to the special places people have come to identify with, and they provide a sense of attachment to nature and a sense of serenity or excitement, depending on the visitor’s interpretation. Scenery provides the backdrop and the setting for the entire forest while defining its character, and it contributes substantially to the experiences people have and seek on the forest. It includes the ecological features and human elements of the national forest, which combine to give an area identity and contribute to a sense of place. Scenery varies depending on existing natural features including vegetation, water features, landform and geology, cultural features, and human alterations (for example, buildings, structures, manipulations of the land or vegetation).

Restoration of vegetation structure and improvement of forest health improves scenery, especially in the long term. Restoration, conservation, and maintenance of grasslands, meadows, riparian ecosystems, and soils also improves scenery. Water features increase the scenic attractiveness of the forest and measures to improve water resources also improve and enhance scenery. Additionally, scenic character is a component of managing for sustainable recreation. Areas of tribal importance, natural and cultural resources, and high places (mountaintops and ridges) also relate to scenic resources.

The Forest Service recognizes the importance of scenery and currently manages the scenic resource through the scenery management system, which is structured to emphasize “natural appearing” scenery, but recognizes scenery more broadly as the visible expression of dynamic ecosystems functioning within “places” that have unique aesthetic and social values. The scenery management system recognizes that in addition to naturally occurring features, positive scenery attributes associated with social, cultural, historical, and spiritual values, including human presence and the built environment, can also be valued elements of the scenery. The scenery management system also allows for “seamless” analysis and conservation beyond national forest lands into adjacent communities and other jurisdictions, through the application of varying scenery “themes” within a single analysis (USDA FS Carson NF 2009).

The forest completed its scenery management system inventory in June 2009, and it would be finalized and incorporated into the plan under any of the action alternatives, replacing the visual quality objectives and visual management system in the existing plan. The scenery management system applies to every acre of the Carson and to all Forest Service activities including, but not limited to, timber harvesting, road building, stream, range, and wildlife improvements, special use developments, utility line construction, recreation developments, and fuels management.

As described earlier, there are spectacular scenic viewing opportunities on the Carson. The scenery management system helps to map these areas based on several characteristics. Scenic class is used for this discussion and figure A-2 (see plan appendix A) and table 70 show the forest broken down by its scenic class ratings. Scenic classes are used as a measure of the value of scenery in a national forest. They measure the relative importance or value of discrete landscape areas having similar characteristics of scenic attractiveness and landscape visibility. The components of scenic classes are scenic attractiveness and landscape visibility. Generally scenic classes 1-2 have high public value, classes 3-5 have moderate value, and classes 6 and 7 have low value.

Table 70. Percentage of Carson National Forest by scenic class and value to the public

Scenic Class	Value to the Public	Area (percent)
1	High	33%
2	High	52%
3	Moderate	8%
4	Moderate	1%
5	Moderate	6%
6	Low	0
7	Low	less than 1%

The majority (85 percent) of the Carson is made up of scenic classes 1 and 2 (table 70). These are the classes that have high public value when combining scenic attractiveness and landscape visibility. Generally, these areas are seen in the middle ground and far off distances. On the scenic class distribution map (refer to figure A-2 in plan appendix A), they are within the Class 2 category and encompass large portions of the forest. The Class 1 areas on the same map include the scenery that the public would enjoy along major travel routes.

Scenic classes 3 to 5 hold moderate value to the public. These classes make up approximately 15 percent of the forest and are predominately found on the west side, which varies in landscape compared to the east side. The small amounts of the moderate scenic classes that occur on the east side are found in small random patches and are generally surrounded by class 1 and 2 areas.

Classes 6 and 7 make up less than 1 percent of the forest. These are the areas that would have low public value and are small enough that they are difficult to find. This small percentage, when compared to rest of the forest, also implies that all of the Carson has scenic value for the public.

Environmental Consequences for Scenery

Methodology and Analysis

Probable management activities related to alternatives 1, 2, 3, 4, and 5 are used to evaluate or predict short- and/or long-term effects to scenery on the Carson. These management activities are evaluated in

relation to their effects on scenic character and scenic integrity. To make broad comparisons between alternatives, this programmatic analysis uses:

- The amount and location of recommended wilderness management areas. The predicted impacts to scenic character and integrity depend on how much recommended wilderness is proposed in an alternative.
- Average acres of ponderosa pine forest and mixed conifer with frequent fire that would be treated with fire (prescribed or managed) or by mechanical means based on the objectives identified for ponderosa pine forest and mixed conifer with frequent fire for each alternative.
- Sustainable grazing objectives related to livestock infrastructure.
- Transportation and access objectives related to roads and trails.
- Invasive species objectives related to treatments.
- Recreation objectives related to dispersed camping.
- Plan components related to scenery for the proposed Developed Winter and Summer Resort (alternatives 2 through 5), San Antonio (alternatives 2 and 4), Valle Vidal (alternatives 2 and 4), Off-Highway Vehicle (alternative 3), and Rio Grande Cutthroat Trout (alternative 4) Management Areas.

Assumptions

Scenery is not expected to be a primary driver in selecting one alternative over another, because predicted impacts between alternatives with regard to scenery are not dramatically different. Differences between alternatives are small because:

- Most noticeable changes to scenic conditions across the landscape occur through natural processes such as wildfires, flooding, or insect and disease outbreaks. These natural disturbances have shaped, and will continue to shape, the vegetation and landform features of the landscape, affecting the overall sustainability of the scenic character.
- Restoration of vegetation structure and improvement of forest health improves scenery, especially in the long term. Restoration, conservation, and maintenance of grasslands, meadows, riparian ecosystems, and soils also improves scenery. Water features increase the scenic attractiveness of the national forest and measures to improve water resources also improve and enhance scenery. All alternatives are expected to achieve desired conditions for scenery in the proposed plan.
- All projects implemented on the forest will require a site-specific analysis of their potential impacts to scenery resources and verification of the need for mitigation to meet or exceed desired conditions.
- None of the alternatives has specific objectives to reduce scenic character and integrity, but resource activities can affect and reduce scenic character and integrity over the short-term. The short-term and long-term environmental consequences to scenery as a result of resource projects and activities would be made at the time of the site-specific decision.
- None of the alternatives prohibit future, site-specific scenery project planning.

Environmental Consequences for Scenery Common to All Alternatives

Each alternative provides for scenery management through visual quality objectives in the case of alternative 1 or scenic integrity objectives under all action alternatives. There is potential for management activities to impact the existing landscape and scenic integrity under all alternatives. Management activities affect scenic resources by altering the appearance of the landscape and include both short-term and long-term effects. Short-term and long-term would be defined in the project-level analysis based on

the potential effects of the activities proposed. Short-term effects on scenery are usually noticeable after project completion and are contrasts to the surrounding natural landscape. Management activities, although they may have some short-term impacts on scenery, also may begin to move the landscape toward the desired scenic character. Effects that move the landscape toward the desired scenic character are often realized over a long period or cumulatively and lead to the lasting sustainability of valued scenery attributes. Project mitigation or design would consider scenic resources under all alternatives and it is assumed that, through site-specific project design or mitigation, the landscape would move toward scenery desired conditions under all alternatives.

There is potential to temporarily impact the existing landscape and scenic integrity from mechanical treatments, fuelwood collection, prescribed fire, roads, and recreation infrastructure. All of the alternatives (1, 2, 3, 4, and 5) use either mechanical treatment or prescribed fire or both as a restoration tool. Scenery would be affected in the short term following each of these activities, but the long-term scenic quality would improve over the landscape. Alternatives 4 and 5 would provide for more areas on the forest with high scenic integrity. Alternative 4 has 45,473 acres of recommended wildernesses and two management areas that prohibit commercial timber harvesting, do not allow new roads open to the public, and provide a more semi-primitive recreation experience. Alternative 5 has 67,996 acres of proposed recommended wilderness and one management area that prohibits new roads open to the public. Alternative 5 has two management areas that provide a more semi-primitive recreation experience. These areas would lead to additional opportunities to experience unaltered landscapes. The limitation of these less accessible areas would be that it would be more difficult for the public to experience and enjoy the scenery.

Mechanical treatment that targets vegetation conditions to reduce the risk of uncharacteristic wildfire or improve watershed conditions would change short-term scenic character where it occurs. Short-term effects to scenery from these types of activities include unnatural appearing slash piles, stumps, bare soil, and scars on remaining vegetation. Depending on the intensity of the treatment, it can result in a forest that looks moderately-altered in the short term. The long-term effects can be beneficial to scenic character. Mechanical treatments typically shift forested lands to a more open vegetative mosaic and provide increased visual access and may make scenic attributes more resilient to uncharacteristic large-scale disturbance. Often variety, texture, and color are enhanced, along with improved wildlife habitat, vegetation, and watershed conditions.

Activities from prescribed fire creates short-term effects to scenic character in the form of burned, blackened vegetation and charred ground surface that are generally considered less attractive but are not necessarily indicative of human alteration. Grasses and other vegetation typically re-sprout within one or two growing seasons after a burn, depending on when the burning occurs and moisture conditions during the growing season. Burn control lines may be evident along maintenance level 1 and 2 travel routes and may detract from a natural appearance. In the long term, prescribed burning usually increases the diversity of texture, color, vegetative size classes, and distribution across the landscape. In the short and long term, prescribed burning often creates the appearance of more uniform ground cover, which is a preferred scenic setting in some landscapes.

Treatment for invasive species is the same across all alternatives. Treatments can include mechanical or chemical treatments, which can leave unsightly dying plants or bare spots on the landscape. Typically, treatment areas are not large in scope, but may occur in or near high use areas or areas of high scenic value. When done appropriately, these activities create a short-term visual impact to an area but provide opportunity for new and more visually appealing vegetation that adds ecological as well as visual value.

Decommissioning of unneeded forest roads to prevent unauthorized, motorized travel can appear unnatural on the landscape. Decommissioning can include berms and trenches that appear like raw piles of earth or can be as extreme as moving large mounds of earth and knocking over trees and other vegetation along an unneeded road. This activity can be unsightly in the short term, but within a few

years, road decommissioning is typically beneficial to scenery resources by recontouring slopes to mimic natural landforms and rehabilitating and revegetating exposed soils typically noticeable on cut and fill slopes created during road construction.

Recreation activities, both developed and dispersed, would continue in all alternatives. Developments for recreation activities are evident, such as roads, trails, and campground and trailhead facilities and they are appropriate for the recreation opportunity spectrum setting (generally rural and roaded natural). The recreation opportunity spectrum incorporates the naturalness of scenery as one of the variables of the setting characteristics. When facilities are designed to blend with the surrounding landscape, they have minimal effects to scenery. Additionally, recreation facilities that conform to the cultural landscape are also appropriate in high scenic integrity areas in rural or roaded natural settings. The location of facilities affects the surrounding setting because they raise the level of concern by becoming viewing platforms for visitors.

All the alternatives have plan direction that allows for developed winter and summer resorts management areas. Alternative 3 would expand the Sipapu Developed Winter and Summer Resorts Management Area. This alternative could impact the scenic integrity by increasing the evidence of human alteration in the management area, depending on what specific alternations or infrastructure additions would be created.

Environmental Consequences for Scenery – Alternative 1

Alternative 1 provides management area-specific goals, objectives, standards, and guidelines for visual quality using the visual management system, which the Forest Service no longer uses. The plan guidance and direction are not relevant for the new scenery management system now used. The 2009 scenery management system inventory replaces the visual management system used in the current plan and provides for a more comprehensive framework for the inventory, analysis, and management of scenery. Continued management under the 1986 Forest Plan (as amended) would not allow for management that incorporates the current scenic management objectives. This alternative does not have the same emphasis on restoration and improved ecological desired conditions as the proposed alternative. Improved ecological desired conditions should help to get to the intent of the scenery management system, which focuses on natural-appearing landscapes expressed as dynamic, functioning ecosystems. Plan direction for visual resources under alternative 1 would not incorporate ecosystem management concepts into scenery management, making it difficult for managers to plan projects and work toward an improved scenic resource condition. For example, healthy, fire-resistant vegetation (for example, vegetation conditions allowing fires to move through the landscape without doing major damage and that recover relatively quickly from fire) is important for long-term scenic quality and scenic character resilience.

Visual quality objective maps would continue to be used during project planning. The visual quality objective maps do not reflect changes in visitor use patterns, do not incorporate views from trails, do not reflect current public opinion (especially concerns about community backdrops and scenery), and do not reflect an ecosystem management landscape context. Additionally, visual quality objectives do not recognize the cultural importance of some human modifications including historic sites, well-designed buildings (such as visitor centers), and human-made features such as campgrounds. Therefore, visual quality objectives do not provide adequate guidance for protecting scenic quality or moving toward desired conditions over the life of the plan.

Alternative 1 proposes no recommended wilderness areas. Recommended wilderness areas would typically have minimal human alteration over the long term and would maintain high scenic integrity for recreational visitors.

Environmental Consequences for Scenery – Alternatives 2, 3, 4, and 5

Alternatives 2, 3, 4, and 5 have ecological desired conditions that focus on vegetation and watershed conditions to restore the landscape to a more natural variable state that improves ecosystem health and function. They all would place a greater emphasis on contributing to the social, cultural, historical, and spiritual values of forest users through access to the forest for forest products, but also on the importance of the scenic quality and the sense of place provided through visual and scenic character. Under all action alternatives, the scenery management system would be fully implemented including desired conditions, objectives, standards, or guidelines to manage scenic resources.

The conversion from visual management system to scenery management system in the action alternatives aligns with current Forest Service policy and is consistent with a shift to ecosystem management benefits and principles and ecological restoration. Activities such as prescribed fire and large-scale vegetation management activities to restore ecosystem functions are examples of management activities that illustrate the benefits of a longer-term scenery management philosophy. These activities may have visually dominant effects in the short term (which may be out of step with adopted scenic integrity objectives), yet typically provide for more positive scenic elements that are generally considered more attractive such as variety, larger trees, and healthier, more resilient vegetation over the life of the plan.

Grazing would continue under all alternatives. Livestock grazing and range facility infrastructure such as fencing, livestock tanks, and corrals are generally small in scale and, while they are evidence of human alteration, when properly located can have minimal impact on the scenic quality of the landscape. Alternatives 2, 3, 4, and 5 contain direction to relocate livestock infrastructure out of riparian areas. Livestock infrastructure within or near high value areas or older unsightly infrastructure can impact scenic integrity in these areas by contrasting with or detracting from an area's natural appearance. Livestock watering areas, if poorly managed and monitored, can cause excessive ecological damage, and impair scenic quality. This condition can be alleviated by appropriate range and livestock management and coordination between range staff and grazing permit holders to balance capacity with allotment conditions.

Alternative 3 focuses more on providing recreational opportunities. This alternative differs from the other alternatives in that it allows more human activity to be visible on the landscape. Increased human presence would probably diminish high quality scenery at recreation sites and maybe, occasionally, along road and trail vistas by increasing evidence of human alteration, such as vegetation trampling and removal. Dispersed camping along roads would occur across all alternatives. Dispersed camping often occurs along riparian areas and within the view of motorized travelers along these routes. Dispersed campsites that see a lot of human activity tend to be altered, with trampled soils and vegetation, litter, and trees that have been cut or damaged. Alternatives 2, 3, 4, and 5 have plan language to close dispersed campsites that have high resource damage and address sites before they become too damaged. Improvement or even decommissioning of the sites would reduce human alteration and improve the scenic quality of the area for recreational drivers and other forest users, and over the long term, could provide improved dispersed campsites that provide better scenic integrity.

Alternative 2 identifies 9,189 acres as recommended wilderness. None of the proposed wilderness in this alternative is in ponderosa pine forest or mixed conifer with frequent fire communities where restoration treatments are required to maintain ecological and scenic integrity. The recommended wilderness would increase high value scenery areas on the forest. Alternative 3 has no new recommended wilderness, similar to alternative 1. Alternatives 4 and 5 identify 47,412 and 67,996 acres, respectively, as recommended wilderness. Most of the vegetation in these are high-elevation forest types where most restoration treatments would be unlikely under all alternatives. These alternatives would increase scenic integrity on the forest.

Alternatives 2, 4, and 5 include two management areas (Valle Vidal and San Antonio) where the emphasis is on managing for natural landscapes, rather than utilization of the resources. Less resource use would decrease or limit impacts to scenic character in these management areas by limiting human alteration. Alternative 4 identifies two additional management areas where the emphasis is on managing for natural landscapes (Wetland Jewels and Rio Grande Cutthroat Trout Management Areas). There are no plan components to manage for high scenic character, but over the long term, limited resource use would limit the evidence of human alteration and increase scenic integrity.

Cumulative Environmental Consequences for Scenery

Some management on adjacent lands complements scenery management by the Carson including lands managed by Taos Pueblo as wilderness, lands managed by the adjacent Rio Grande and Santa Fe NFs, and lands managed by the BLM, which uses a visual resource management system. Counties with open space or scenery-related language in guiding documents or plans also complements scenery management of the Carson across ownership boundaries.

The Carson has both the Sangre de Cristo Mountains on the east side of the forest and the Pecos Mountains on its west side, includes the highest elevations in northern New Mexico, and offers some of the most spectacular scenic opportunities from the adjacent roads and communities and within the forest. There are other Federal, State, and private lands that provide remarkable scenery and viewing opportunities throughout the region. Loss of quality scenery and viewing opportunities within or surrounding the forest would have a negative impact upon the quality of the experiences enjoyed by both visitors and local communities.

Landowners who do not manage for scenery may have noticeable differences in levels of development across boundaries that could impact the scenic quality in areas such as scenic byways. For example, the State of New Mexico manages State Trust Lands to optimize economic benefit for the trust beneficiaries (including schools, universities, hospitals, and public institutions). While these lands permit public access, they are not managed like other public lands such as national forests or national parks. As these lands are managed, leased, or auctioned, scenic resources may or may not be considered.

Since most private lands and other ownerships do not have regulations for scenic resource management, the effects of ongoing developments adjacent to National Forest System lands can sometimes have negative effects on scenic resources across the continuous landscape. Forest visitors often view scenery as a single landscape with little discernment between land ownerships. Sometimes management activities occurring at ownership boundaries can be quite noticeable if the change in form, line, color, or texture of the activity follows ownership boundaries rather than a natural landscape feature. If activities on private lands are designed to lessen impacts to scenic resources, the difference between private lands and National Forest System lands are less apparent. The regional, county, and community plans inclusion of scenic or aesthetic resources or open space character helps promote the management and value of scenic resources across ownership boundaries in the cumulative consequences analysis area.

Several large utility companies have proposed major electrical transmission lines through the region. A group is proposing to run a major transmission line across the state of New Mexico, which would cut through the Carson and BLM lands. The local utility is in the process of converting electrical power generation to large solar fields, to be located throughout the region. As electrical infrastructure ages around the country and electrical suppliers consider alternative energy sources, such as wind and solar, there may be more transmission and distribution infrastructure visible on the landscape. Some of this infrastructure may be in high scenic areas and energy infrastructure could impact and degrade previous high scenic integrity areas by increasing the amount of landscape alteration and evidence of human development.

The population in northern New Mexico has not grown in recent years and this trend is expected to continue. Most of the communities surrounding the forest are small rural towns with natural-appearing landscapes. The lack of expansion should result in minimal change to the landscapes in and around these communities. The Taos and Santa Fe areas have become places for large second homes or retirees moving to the area. Many of the homes are being built in forested areas adjacent to the national forests. These homes add roads and infrastructure to areas that could affect scenic viewsheds and they may impact the scenic integrity of previously forested or rural areas.

Natural resources and settings would be vulnerable to adverse effects of atypical temperatures and rainfall patterns from climate change. Some associated effects include drought, increased number and intensity of wildfires, increased insect and disease outbreaks affecting vegetation, and decreased water yield and availability. Severe wildfires would remove forest vegetation and diminish the scenic quality of the landscape, especially when a wildfire burns at an uncharacteristic scale or severity. When fires burn at high intensities over large areas, as is more likely during severe drought and increased temperatures, heavy runoff from extreme storms may remove soils and reduce surface vegetation, which would reduce the quality of scenic vistas. When insect and disease outbreaks occur at epidemic levels, tree mortality with standing and fallen dead trees would reduce scenic quality especially when the mortality dominates scenic vistas. Defoliation of trees from insects and disease would also affect the scenic quality, changing the scenic views while trees are defoliated.

Transportation and Forest Access

Description of Affected Environment

Transportation Infrastructure

Well-maintained and sufficient road infrastructure is important for safe, reliable, and convenient access to NFS lands and private inholdings. National Forest System roads on the Carson are those that are under the jurisdiction of the Forest Service and have been determined to be necessary for the protection, administration, use, and development of resources on the forest. Other roads managed by public road agencies such as states, counties, and municipalities help provide access to NFS lands. These roads are not under the jurisdiction of the Carson and are not included in this analysis. Transportation infrastructure also includes bridges and other road infrastructure, which provide access for administration of the forest, public recreation, and forest product extraction.

Primary Access Routes Servicing the Forest

Primary motorized access to and through the Carson is by a network of Federal, State, and county highways. Visitors, as well as local communities, have ample opportunity to experience, use, and enjoy the forest from all parts of New Mexico and surrounding states. These roads are well maintained and typically open year-round. High mountain passes through the forest are subject to periodic closure during heavy winter snows. Both maintenance and winter snowplowing of these roads are the responsibility of the relevant government entities. Many of these roads serve as primary access for communities into and around the analysis area. Currently, there are no new major road or bridge projects planned or underway within the analysis area.

Forest Transportation System

Carson NF motor vehicle use maps (USDA FS Carson NF 2018b, 2018c, 2018d, 2018e) identify 2,613 miles of roads on the forest that are open to public use. National Forest System roads are assigned a maintenance level ranging from 1 to 5, depending on the intended use of the road and corresponding level of maintenance required. Maintenance level 1 roads are roads placed in storage, and not open for

motorized use. Maintenance on maintenance level 1 roads preserves drainage and runoff patterns but road deterioration may occur. Maintenance level classes increase in terms of level of comfort and appropriate vehicle type up to maintenance level 5, which are designed for passenger vehicles and provide the highest degree of user comfort and convenience for standard passenger cars.

Approximately 2,130 miles (84 percent) of roads on the Carson are designated maintenance level 2 and are only suitable for high clearance vehicles. The remaining publicly accessible roads (484 miles) are maintenance level 3 to maintenance level 5 and are maintained for passenger vehicle use. Maintenance level 5 roads require the greatest amount of effort to maintain.

Maintenance of forest roads occurs mainly between early May and November, weather permitting. At high elevations, heavy winter snows prohibit safe access for crews to evaluate road conditions or perform maintenance outside this time period. Weather has a major influence on road conditions on the Carson. Day and nighttime temperature fluctuations during winter months create continuous freeze-thaw conditions, which can create potholes and damage roads. Summer monsoons can cause extensive flooding and high surface runoff, which fill drainage ditches with debris, create ruts, and erode road surfaces.

Road maintenance includes preserving the entire roadway, including surface, shoulder, roadsides, and structures necessary for safe and efficient use. Many maintenance level 2 roads do not receive maintenance on a regular interval. Current funding levels do not support necessary maintenance of all NFS roads, resulting in a large backlog of deferred maintenance. Deferred maintenance is maintenance that was not performed when it was needed or scheduled but has been put off into the future. Currently, the deferred maintenance backlog for the Carson is \$4.8 million. Since 2010, funding levels for road maintenance have remained constant, averaging about \$711,000 per year. There are indications that road maintenance funding may remain constant or decrease in the future. The result may be less regular road maintenance, which could lead to increasing deterioration of NFS roads over time, particularly maintenance level 3 roads, which typically have gravel or well-compacted dirt surfaces. Maintenance level 3 to maintenance level 5 roads would be the priority for maintenance, as public traffic safety is a high priority, but the Carson may experience longer intervals in the maintenance of some maintenance level 2 roads.

Maintenance on approximately 263 miles of maintenance level 2 roads on the Jicarilla Ranger District is funded and accomplished by the oil and gas industry, as part of their lease operations.

Bridges

The Carson has 22 road bridges as part of its transportation system. Fourteen of these are rated in “good” condition and eight are in “fair” condition. The bridges in fair condition are currently safe for vehicular travel but require maintenance to bring them up to a higher standard. All but one of the forest’s bridges were built before 1975, and many of these structures now do, or in the future will, require extensive rebuild or replacement as they get older. The current deferred maintenance for bridges on the forest is \$1.2 million.

Trail System

Trails are a part of recreation facilities. The Carson administers a total of 684 miles of trails, of which 85 miles are designated as motorized trails and 599 miles are non-motorized trails. Over the past 5 years, the Carson has annually maintained 100 to 110 miles or around 20 percent of its trails to Forest Service standard. Maintenance work has included removal of downed trees, tread restoration, and brushing back encroaching vegetation. Fallen trees along trails after heavy snows create the majority of the maintenance work.

The non-motorized trail system is currently in good shape. Trail crews have been able to provide adequate maintenance on a recurring cycle. Trail signage is not in good condition on many trails. Intense sunlight,

winter snows, and some vandalism have taken a toll on signage, and the forest has not been able to keep up with the required repair or replacement. The motorized trail system has many areas in poor condition and most of the trails are deeply rutted and eroded. Maintenance of motorized trails requires mechanized equipment and is more labor intensive. With limited workforce and financial capacity, the forest is challenged to adequately maintain these trails. The majority of motorized trails are on the Camino Real Ranger District, and riding of off-highway vehicles on unauthorized trails has resulted in damage to vegetation and increased erosion and sedimentation. With implementation of the Travel Management Rule, the forest is working to close and prevent access on unauthorized trails and roads.

Historically, recreation funding has decreased each year. The projected trend is for funding to continue to decrease. With the emphasis on developing a sustainable recreation program, the need for safe, accessible, and maintained-to-standard trails will be an ongoing requirement. The forest cannot currently maintain motorized trails to standard and new signage will be required on a regular basis. The ability to continue to maintain non-motorized trails to standard may also be impacted.

Environmental Consequences for Transportation and Forest Access

Methodology and Analysis

Probable management activities related to alternatives 1, 2, 3, 4, and 5 are used to evaluate or predict short- and/or long-term effects to transportation and forest access on the Carson. These management activities are evaluated in relation to their effects on the ability to construct and maintain roads and trails to standard. To make broad comparisons between alternatives, this programmatic analysis uses:

- The amount and location of recommended wilderness management areas. The predicted impacts of an alternative on recreation settings and motorized and non-motorized recreational opportunities vary depending on how much recommended wilderness is proposed and where it is located.
- Average acres of ponderosa pine forest and mixed conifer with frequent fire that would be treated with fire (prescribed or managed) or by mechanical means (timber harvesting and thinning) based on the objectives identified for ponderosa pine forest and mixed conifer with frequent fire for each alternative.
- Recreation objectives related to mountain bike trails.
- Transportation and forest access objectives related to roads and trails.
- Stream objectives related to road stream crossings.
- Plan components related to transportation and forest access for the proposed, San Antonio (alternatives 2 and 4), Valle Vidal (alternatives 2 and 4), Off-Highway (alternative 3), and Rio Grande Cutthroat Trout (alternative 4) Management Areas.

Assumptions

Access and transportation is not expected to be a primary driver in selecting one alternative over another, because predicted impacts between alternatives with regard to access and transportation are not dramatically different. Differences between alternatives are small because:

- Transportation and forest access use across all alternatives is anticipated and assumed to remain relatively constant. As such, the ability to maintain existing and potential new roads and trails would ultimately be limited by funding levels and contributions from partnerships.
- All alternatives are expected to achieve desired conditions for access and transportation in the proposed plan.

- All projects implemented on the forest would require a site-specific analysis of their potential impacts to road and trail resources and verification of the need for mitigation to meet or exceed desired Forest Service standards.
- None of the alternatives identifies specific new roads or motorized or non-motorized trails to be constructed. Proposals would be considered through project-level planning. The environmental consequences of new roads or trails or other motorized uses will be identified and analyzed at the project level and any changes to motor vehicle use maps would be made under a separate decision.
- None of the alternatives removes roads or trails from the existing system of open roads and trails.

Environmental Consequences for Transportation and Forest Access Common to All Alternatives

Roads and trails are how most of the public accesses the forest to enjoy and use its many natural resources. Well-maintained, safe, and well-planned road and trail systems are necessary to contribute to user's experience. These systems must be maintained and operated to meet many different user needs such as recreational driving and viewing, snowmobiling, ATV riding, mountain biking, hiking, walking, hunting, and fuelwood gathering. When these systems are not well maintained and planned, their use is interrupted, or they impact other resources, then the user experience and opportunities for multiple uses are reduced. All the alternatives place an emphasis on maintaining roads and trails in a safe condition, with appropriate signage, and to minimize the impacts to ecological resources.

Under all alternatives, major roads necessary for through traffic would remain open. No specific roads or trails are identified for closure or opening through this plan decision. Road decommissioning would be determined on a case-by-case basis, taking into consideration long-term need, and under a subsequent decision. Under all alternatives, new motorized access would be restricted in several locations including designated wilderness, primitive recreation opportunity settings, wild classification eligible wild and scenic rivers, and proposed research natural areas.

In general, the presence of roads on the Carson increases access for the public, supporting multiple uses like recreation, fuelwood collection, grazing, hunting, fishing, and sightseeing. Roads make participation in multiple-use activities easier, increasing user satisfaction and visitation, and bringing economic revenue to surrounding communities. Roads increase access for livestock producers, facilitating grazing operations that contribute to local economies and sustain traditional uses. Motorized access eases the collection of forest products such as fuelwood, piñon nuts, Christmas trees, mushrooms, wildings, and medicinal plants, supporting the continued cultural and traditional uses of these products.

Oil and gas development and production currently occurs within the Jicarilla Natural Gas Management Area. Under all alternatives, the effects of short- and long-term consequences of this include increased traffic conflicts with other users on forest roads. As part of oil and gas lease agreements, industry funds and maintains forest roads within the Jicarilla Natural Gas Management Area. As of 2015, this shared management improved the maintenance of approximately 263 miles of roads on the Jicarilla Ranger District on an ongoing basis.

Roads also provide necessary access to complete vegetation management and other restoration treatments to increase ecosystem diversity and resiliency. They ease access for firefighters, increasing their safety and the safety of the public, and improving protection of values at risk. They provide access for administrative activities such as law enforcement and facilities maintenance.

Under all alternatives, climate change and drought will likely reduce access and require additional maintenance because of the increased likelihood of catastrophic wildfire, flood events, and other uncharacteristic natural disasters, which can lead to erosion, fallen trees, damaged culverts, and wash outs. Wildfires can cause direct impacts to infrastructure, such as burned bridges or temporary road

closures and indirect impacts from elevated runoff or increased wear and tear from incident response. Insects, disease, and drought are expected to lead to increased tree mortality and more hazard trees or downed trees across roads and trails that need to be cleared. Extreme heat may cause pavement to buckle (USDA FS 2018c).

Limited funding and workforce capacity to properly maintain roads and trails has been identified as the biggest challenge to providing quality public access, which could impact user experience and the opportunity to use and benefit from forest resources. The Carson does not have the capacity to maintain existing system roads and trails to prevent negative impacts to ecological resources. The forest does not have the capacity to plan, build, or maintain new trails to meet the anticipated recreation demands of current and future forest users. The action alternatives place a greater emphasis on working with partners to fund, plan, build, and maintain new, non-motorized trails and to fund and maintain existing roads. By working with partners and other stakeholders, the Carson would be better able to provide and maintain new trails and provide better access for forest users. By using partners and stakeholders to maintain existing roads—primarily maintenance levels 2 and 3—the forest would be able to provide forest users access that is safe and reliable and that would have fewer negative impacts on ecological resources.

Environmental Consequences for Transportation and Forest Access – Alternative 1

In alternative 1, management of transportation and forest access would continue under the management area-specific goals, objectives, standards, and guidelines in the 1986 Forest Plan (as amended), which are driven primarily by timber harvesting. Alternative 1 provides plan language to manage system roads and trails so that they are safe, operable, and function at the appropriate maintenance level. There is also plan language that states that roads that cannot be maintained or that cause resource damage should be closed. Alternative 1 plan language states that motorized travel is restricted to roads identified on the motor vehicle use map as open to the public. This alternative has plan language that is ambiguous and uses poorly defined terminology.

Maintaining the current levels of road and trail access would sustain multiple forest uses such as recreation, fuelwood collection, grazing, hunting, fishing, and sightseeing. Decisions to open or close roads would be based on project-specific analysis of need and impacts. Unmet demand for additional, and better maintained motorized trails would likely continue to drive illegal use on closed and non-system roads and trails. A lack of effective road decommissioning and closure enforcement would allow continued illegal use of closed and non-system roads. This additional motorized use in areas that are not designated as part of the system, and not maintained for that type of use would lead to increased soil erosion and compaction, reduced water infiltration and increased runoff, decreasing water quality, increased noise and habitat fragmentation, and negative impacts to archeological sites.

Environmental Consequences for Transportation and Forest Access – Alternative 2

Under alternative 2, the forest would increase mechanical treatment and prescribed burning. Increased mechanical and prescribed fire treatment could temporarily impact road access in those areas being treated. Some roads may be temporarily closed for the public's safety, which would reduce access to multiple uses. Roads that are not closed but are near a treated area may have logging trucks or other equipment using them, which may present driving hazards to other motorists using them. Other potential negative impacts from mechanical treatments are the creation of temporary or new permanent roads in project areas. Additional roads would have negative impacts such as soil compaction and habitat fragmentation that may be temporary or long-term depending on the road type. Alternative 2 has plan language that would mitigate the effects of creating temporary roads or opening new roads, by decommissioning unneeded roads elsewhere on the forest and by obliterating or naturalizing unneeded roads. Mechanical and prescribed fire treatment activities could result in the temporary closure of roads

and trails, impacting opportunities for recreational hiking, biking, and ATV use; fuelwood collection; hunting; and permitted uses.

There are objectives related to reducing the number of non-system roads that potentially impact other ecological resources. Alternative 2 has plan language to decommission temporary roads following project completion, which would result in fewer unauthorized roads that are accessible to the public and would reduce effects on ecological resources. Less illegal motorized use would reduce soil erosion and compaction, improve water infiltration and slow runoff, improve water quality, decrease noise and habitat fragmentation, and reduce negative impacts to archeological sites. Alternative 2 also includes plan language to maintain and improve existing road infrastructure to reduce impacts to wildlife, such as stream fragmentation or vehicle collisions.

Objectives in alternative 2 emphasize obliterating or naturalizing unneeded roads. This would restore more natural drainage patterns and improve habitat connectivity by recontouring and revegetating roadbeds. It would have positive impacts on water quality by reducing erosion and sedimentation. It would also better prevent unauthorized use compared to other methods of decommissioning such as signing or berming.

Alternative 2 includes the Valle Vidal and San Antonio Management Areas, which have plan language restricting construction of new roads for public access. These are both large areas with few existing public access roads. Prohibiting new roads would help preserve the ecological integrity of the area by protecting soils, vegetation, and wildlife from vehicle disturbance. Opportunities for future motorized uses for economic benefit and recreation experience would be limited, and there may be increased ecological impacts, and a degraded user experience on other parts of the forest. This alternative would impose seasonal road closures in the Valle Vidal Management Area to protect elk winter range, which would limit access to other multiple uses such as snowshoeing and cross-country skiing.

This alternative recommends 9,189 acres as wilderness. This would increase the acreage where no new roads or motorized trails could be constructed. Recommended wilderness eliminates the potential to add new roads to the transportation system in those locations. Existing trails would remain, and new non-motorized trails could potentially be added to recommended wilderness areas.

Compared to alternative 2, alternative 3 decreases the number of miles obliterated or naturalized by this objective and alternative 4 increases them. Alternative 4 also has specific management areas that direct management to decrease temporary roads and motorized travel.

Environmental Consequences for Transportation and Forest Access – Alternative 3

Alternative 3 would treat the most acres mechanically, which could increase the number of temporary road closures during treatment. Roads may need to be temporarily closed for the public's safety, temporarily reducing opportunities for access to areas where treatment activities are occurring. Roads that are not closed but are near a treated area may have logging trucks or other equipment using them, which may present driving hazards to motorists. Additional mechanical treatment would require more temporary or new permanent roads in the project areas with associated negative impacts such as soil compaction and habitat fragmentation that may be temporary or long-term depending on the road type.

Compared to alternative 2, alternative 3 deemphasizes the use of fire as a restoration treatment in suitable timber and near trails. Reduced prescribed fire would reduce the potential for road and trail closures due to smoke or public safety. However, the threat of uncharacteristic wildfire would increase and may lead to less access overall as roads are closed during suppression or a result of post-fire damage.

Alternative 3 emphasizes conversion of project-level roads to system roads or motorized trails rather than considering them temporary and decommissioning them following project completion. More open motorized trails and roads would improve visitor access and provide additional motorized recreational

opportunities. More access supports multiple uses like recreation, fuelwood collection, grazing, hunting, fishing, and sightseeing. It provides more opportunities for collecting other forest products such as piñon nuts, Christmas trees, and medicinal plants. However, it detracts from non-motorized recreation such as hiking, mountain biking, experiencing solitude, and wildlife viewing. More roads and motorized trails would increase soil erosion and compaction, reduce water infiltration and increase runoff, decrease water quality, and increase noise and habitat fragmentation.

Alternative 3 has objectives to increase the rate of road maintenance, which would partially offset some of the negative ecological impacts listed above and improve visitor experience. But without increased funding for road maintenance, that additional work would be at the expense of other work that could be accomplished in other program areas. One tradeoff would be to reduce the number of unneeded roads that are obliterated or naturalized. Unneeded roads that remain on the landscape would intercept surface water flow, concentrate runoff, increase sedimentation, and reduce habitat connectivity.

Alternative 3 includes a new management area that encourages cross-country motorcycle and off-highway vehicle rock-crawling uses. Future development and use of these areas for those purposes is a desired condition but the specific location or impacts would depend on specific future uses. The Off Highway Vehicle Management Area would increase opportunity for motorized recreation, particularly related to more challenging trials motorcycle or off-highway vehicle rock crawling terrain. This management area could have positive impacts elsewhere on the forest by reducing unauthorized use of off-highway vehicles on closed roads or cross country. Additional and concentrated motorized use, particularly off engineered roads would degrade water quality due to increased erosion and deposition of vehicle lubricants. It would degrade wildlife habitat through vegetation crushing and noise.

Alternative 3 does not include the Valle Vidal and San Antonio Management Areas, which would allow those areas to be available for new system road construction. That would provide the potential for more access to those areas for fuelwood, hunting, and sightseeing and more opportunities for motorized recreation. It would negatively impact opportunities for hiking, wildlife viewing, and experiencing solitude. Alternative 3 does not include any recommended wilderness, which would provide the most opportunity for future road or motorized trail construction.

Environmental Consequences for Transportation and Forest Access – Alternative 4

Alternative 4 places an emphasis on natural processes while deemphasizing motorized access. Mechanical restoration would be deemphasized as a management tool, which would result in fewer temporary roads to support this activity and fewer road closures for public safety. This alternative focuses on restoration accomplished through increased application of prescribed fire and naturally ignited fires managed to benefit resource values. More fire on the landscape would result in more temporarily closed roads for public safety. The net effect on access would probably be negative because fire and smoke are less predictable than mechanical treatment and closures can be better planned in advance to have less impact on public access.

Alternative 4 identifies Wetland Jewel Management Areas where wetland restoration work would occur on the forest. Obliterating and naturalization of unneeded roads would occur in these areas at an accelerated pace, but prior to anywhere else on the forest. This would improve water quality, restore watershed hydrology, and improve habitat in these management areas. But it would also significantly reduce the number of unneeded roads that would be obliterated or naturalized anywhere else on the forest. Those unneeded roads remaining on the landscape would intercept surface water flow, concentrate runoff, increase sedimentation, and reduce habitat connectivity.

No new permanent roads or motorized trails would be constructed in these Wetland Jewel Management Areas. In 51 percent of the management area where there are no other prohibitions on road construction

(wilderness, recommended wilderness, inventoried roadless area), this restriction would eliminate the potential for additional soil compaction, sedimentation, or habitat fragmentation from roads.

One transportation system-related guideline would be converted to a standard under alternative 4 (FW-TFA-S-4). Standard FW-TFA-S-3 would be more narrowly defined to require temporary road obliteration or naturalization instead of just decommissioning. Both would require decommissioning, obliteration, or naturalization even when that action would not offset resource damage, protect watershed condition, minimize wildlife disturbance, or prevent illegal motorized use. Under any circumstance where road decommissioning, obliteration, or naturalization would offset, protect, minimize, or prevent those impacts, a guideline would have the same results as a standard. In cases where those impacts would not be affected, the plan components in this alternative would divert resources from other areas where they could positively offset resource damage, protect watershed condition, minimize wildlife disturbance, or prevent illegal motorized use. Since road obliteration and naturalization would be focused first in the Wetland Jewel Management Area (MA-WJMA-O-4), that would be delayed or limited in other areas of the forest, and as a result, construction of temporary roads for ecosystem restoration activities, fuels management, or other short-term projects would be very unlikely. Without fewer roads to conduct restoration and fuels management work, riparian areas, forests, grasslands, and fire regimes would be more departed than under alternative 2.

This would have little effect other than to remove any possibility of future legal public access to any temporary roads used for ecosystem restoration activities. This could reduce access in rare cases where a temporary road was later determined to be beneficial as a system road for public use. In most cases, the determination that the purpose of a road is temporary and project specific remains in effect. In all cases, the conversion from guideline to standard would have no greater effect on offsetting resource damage, protecting watershed condition, minimizing wildlife disturbance, or preventing illegal motorized use because those are included in the intent of the guideline and would have to be addressed any time the guideline was applicable.

Motorized, over-snow use is prohibited in the Valle Vidal and San Antonio Management Areas under alternative 4. This would decrease the opportunity for this recreational activity on the forest and may impact the overall user experience, particularly in the northern Tres Piedras district, which is very popular for snowmobiling. It would reduce winter noise in these areas and likely have a positive impact on wildlife habitat. This alternative adds seasonal closures to all cross-country travel to protect winter range for elk that would significantly decrease access to the San Antonio Management Area. There may be some minor benefit to elk populations from the closure of the Tres Piedras portion, but no benefit on the Questa portion. Open system roads, which are numerous in the Cebolla Mesa area, would remain open, and that Questa Ranger District portion of the San Antonio Management Area is not heavily used by elk as winter range. There would be substantial impacts to recreational access by closing popular snowmobiling, fishing, and hiking areas.

This alternative proposes 45,473 acres of recommended wilderness, which would limit new roads or motorized trails and opportunities for motorized use. Existing trails would remain, and new non-motorized trails could potentially be added in recommended wilderness.

Environmental Consequences for Transportation and Forest Access – Alternative 5

Alternative 5 has the same plan language as alternative 2. This alternative differs only in that it has more acres (67,996) of recommended wilderness. Recommended wilderness would limit new roads or motorized trails and opportunities for motorized use. Existing trails would remain, and new non-motorized trails could potentially be added in recommended wilderness.

Cumulative Environmental Consequences for Transportation and Forest Access

State and local government agencies with road management authority can be expected to continue to maintain their existing road network across the Forest. Some changes such as widening, resurfacing, and bridge replacements are probable but are dependent on budgets and funding allocations. The likelihood of jurisdiction of NFS roads being passed to other public road agencies is low. There are no known major construction or rerouting projects around the Carson that would affect motorized access to or around the forest within the life of the plan.

The Carson is surrounded primarily by rural communities; the largest incorporated community is Taos, New Mexico, with about 6,000 people. The forest has several incorporated communities and as many as 54 unincorporated communities within the forest's boundaries. Maintaining access to these communities, whether via State or Federal highways, county roads or forest roads, is imperative. Forest activities and projects that interrupt access could have significant effects on the economies and livelihoods of these small communities. Access through and around the forest is critical for many of these communities to go to the grocery store, the doctor, one's place of employment, or just to visit family. None of the potential recommended wilderness areas, management areas, or other management in any of the alternatives would affect these major access routes.

Residents of small communities within and near the forest require firewood to heat their homes in the winter, and many households cook with firewood. It is essential that roads into and within the forest be well-maintained to accommodate motorized vehicles for access to fuelwood sites. Additional fuelwood areas on BLM lands in northern New Mexico supplement fuelwood collection on the Carson.

The Carson has been growing as a destination for recreational activities and vacationing. Many local communities, as well as the state of New Mexico, have also put an emphasis on increasing visitation. Adjacent recreational attractions such as Eagle Nest Lake, Angel Fire ski and summer resort, the Chama area, and the BLM Rio Grande del Norte National Monument bring additional recreational visitors to the area. The expanded Taos airport is likely to increase visitation to the area. Alternatives 2, 3, 4, and 5 emphasize recreation activities to provide improved visitor experience and opportunity. More visitors put increased stress on local road systems, which could require local counties and communities to maintain their road systems more often and potentially plan for improving and increasing the volume on local road systems. The state of New Mexico is currently widening Hwy 64/68 through Taos, which is the main artery from north to south. Construction could discourage visitation or create traffic delays for visitors using the highway to access the Carson NFS lands.

An increase in outside visitation is desired by the Forest, State, and many local communities, but is not guaranteed. Well-maintained and safe road access both external to and within the forest help improve overall visitor experience and could have an effect on attracting others to visit the area. The population around the forest has been somewhat constant during the last several years. While density of population may not affect existing volume on road infrastructure, many county and local roads are older and potentially in need of major repair. Reconstruction of aging road systems can be costly, and lack of available funding may delay needed repairs. Many of the Federal, State, county, and local roads are two lanes. Recent replacement of the main gas line to the Taos area resulted in a primary access route being reduced to one lane for almost nine months.

Facilities Infrastructure

Description of Affected Environment

Administrative Facilities

Nine administrative sites on the Carson contain 99 individual administrative buildings that need maintenance. Sites include the Supervisor's Office, six ranger stations, the Cañon Administrative Site (Camino Real Ranger District), and one unoccupied visitor center complex (Canjilon Ranger District). The Supervisor's Office in Taos and the Jicarilla Ranger Station are leased, the others are owned by the Forest Service. The Jicarilla Ranger District also leases a 7-acre site from the BLM to house wild horse captures. With the exception of the Jicarilla Ranger Station, the ranger stations are self-contained compounds, typically including an office, warehouse/shop, residences/crew quarters, materials storage sheds, horse facilities, and water/wastewater systems. The Cañon Administrative Site includes living quarters for the Carson Hotshots (fire crew) and a house for seasonal employees.

The Piedra Lumbre Visitor Center (Canjilon Ranger District), formerly the Ghost Ranch Living Museum, is currently unoccupied and not in use. Under the Forest Service Facility Realignment Act, this facility has been approved for conveyance. Several steps, including a hazardous materials assessment, must occur before it can be transferred to another owner.

The deferred maintenance of administrative facilities on the Carson, excluding the visitor center complex, is valued at over \$1.6 million dollars. Many of the facilities identified as being in poor condition are historic adobe buildings. These buildings are being maintained to address only required health and safety issues. Priority for maintenance is given to office, residential, and warehouse buildings. The facilities budget for maintaining these buildings has not increased in recent years, leading to the significant deferred maintenance backlog. Future funding is not expected to increase, resulting in a decline in the condition of other administrative facility structures.

Recreation Facilities

The Carson has 32 developed campgrounds. The Echo Amphitheater site has flush toilets, all other campgrounds have vault toilets, and 10 campgrounds provide drinking water. Four sites have horse corrals and five sites have pavilions with picnic facilities. Most of these sites have routine maintenance performed by a contracted concessionaire. The Forest Service performs major construction and repairs at the sites. Except for several vault toilets that are in poor condition, the campsites are maintained to Forest Service standards and overall are in good condition. The forest's current budget for recreation maintenance is inadequate to properly maintain all recreation facilities. The budget for recreation maintenance has been steadily decreasing. Future funding for recreation maintenance is not expected to keep up with required maintenance needs.

Drinking Water Systems

The Carson has 13 drinking water systems (10 systems serve recreational facilities and 3 serve administrative sites). The remaining administrative sites are served by municipal water systems. All the recreational drinking water systems were developed or improved during the 1990s, and are currently in good condition.

Wastewater Systems

The Carson administers 19 wastewater systems. Eighteen serve the administrative sites and one is located at the Echo Canyon Amphitheater Day-Use Area. Two of the administrative sites are on municipal

systems; the others are either traditional, gravity-fed septic tank and leach field systems or, where high water tables are an issue, septic tanks with lift stations that move wastewater up to a mounded leach field.

There are 88 vault toilets as part of the recreation facilities (campground, trailhead, or day-use area). The majority of the vault toilets on the forest were installed in the 1970s and '80s, but have been replaced in the last 20 years as part of campground reconstruction projects. In the 1990s, several new vault toilets were installed as part of new or expanded recreation areas. Currently, 41 vault toilets are in good condition, 29 are fair, and 18 are in poor condition. Approximate replacement value for one vault toilet is \$40,000. The 18 vault toilets in poor condition will probably not be replaced in the near future because of limited recreation funds.

The deferred maintenance of septic/wastewater systems on the Carson is estimated at \$280,000. Once a septic tank/leach field system fails, it must be entirely replaced. Since wastewater is an important health and safety issue, funding for future administrative site wastewater projects is a priority.

Dams

The Carson has 23 inventoried earthen dams located with the plan area. Twenty-two of these dams were constructed to create recreational fishing areas. The Cabresto Dam was constructed as an irrigation dam for farmland in the Questa area. This dam is permitted to the Llano Irrigation District, which is responsible for its operation and maintenance. It is one of two on the forest identified as high hazard dams. The other is the Upper Shuree Pond Dam, located in Valle Vidal. This dam impounds the largest body of water on the forest and needs repairs estimated at up to \$1.5 million.

Half of the remaining 21 dams need some repair. The remaining dams need minor maintenance. The deferred maintenance for these dams is \$360,000. Failure of any of the 23 recreational dams would result in the loss of recreational fishing opportunities. The Carson assessment identified two high hazard dams and five significant hazard dams, failure of the high hazard dams could result in a loss of life and environmental damage downstream. Failure of any of the significant hazard dams would potentially cause environmental damage downstream.

Communication Sites

The Carson has three designated communication sites. One is located on San Antonio Mountain, one on Sawmill Mountain, and one on Picuris Peak. These sites are used under permit by other entities for their communication equipment needs. There are 8 administrative sites and 14 remote sites throughout the forest that have communication equipment used exclusively by the Carson. Currently, most of the communication equipment and sites are in good condition.

To date, the Carson has been able to readily identify any maintenance issues and keep the sites in good condition. The average age of the communication equipment on the forest is about 10 years. Most of this equipment will be up for replacement in the next five years. The cost for replacement is borne by the Forest Service Chief Information Office, not the Carson.

The continued maintenance and service of the communication sites and equipment is critical for Forest Service personnel and public safety. Most of the forest is not accessible to mobile phone service. The current trend is that funding is available when needed to perform communication infrastructure maintenance.

Environmental Consequences for Facilities Infrastructure

Methodology and Analysis

Probable management activities related to alternatives 1, 2, 3, 4, and 5 are used to evaluate or predict short- and/or long-term effects to facilities infrastructure on the Carson. These management activities are evaluated in relation to their effects on the conditions and maintenance of facilities infrastructure. To make broad comparisons between alternatives, this programmatic analysis uses:

- The amount and dispersal of proposed recommended wilderness management areas. The predicted impacts to new and existing facilities opportunities vary, depending on how much recommended wilderness is proposed in an alternative.
- Average acres of ponderosa pine forest and mixed conifer with frequent fire that could potentially be treated with fire (prescribed or managed) or by mechanical means (timber harvesting and thinning) using the objectives identified for ponderosa pine forest and mixed conifer with frequent fire for each alternative.
- Recreation objectives related to the maintenance and improvement of campsites facilities.
- Plan components related to recreation for the Developed Winter and Summer Resort (alternatives 2 through 5) and Valle Vidal (alternatives 2 and 4) Management Areas.

Assumptions

Facilities infrastructure is not expected to be a primary driver in selecting one alternative over another, because predicted impacts with regard to recreation are not dramatically different among alternatives. Differences across alternatives are small because:

- The amount of facilities infrastructure is anticipated and assumed to remain constant, while maintenance needs of this infrastructure is anticipated and assumed to increase across all alternatives as structures age.
- All alternatives are expected to achieve desired conditions for recreation.
- All projects implemented on the forest would require a site-specific analysis of their potential impacts to facilities resources and verification of the need for mitigation to meet or exceed desired conditions.
- None of the alternatives has specific objectives to construct new facility infrastructure, but there are specific objectives to reduce the backlog of developed recreation sites during the life of the plan. Proposals would be considered through project-level planning. The environmental consequences of facilities maintenance activities are identified and analyzed at the project level.
- None of the alternatives prohibits future site-specific facilities infrastructure project planning, improvement, construction, replacement, or decommissioning.

Environmental Consequences for Facilities Infrastructure – All Alternatives

No management objectives or travel management decisions regarding access would be modified unless a separate analysis occurred, and facilities would continue to receive annual maintenance according to the existing forest budget and schedule under all alternatives. Construction or reconstruction of capital improvements to support fire, administrative, and other multifunctional activities would occur in compliance with FSM 7310 and energy conservation requirements. Maintenance or upgrades (minor betterment) of capital improvements to support fire, administrative, and other multifunctional activities would occur to abate serious safety hazards. The Facility Master Plan would be reviewed and updated annually as necessary to reflect management needs. The current maintenance level and the condition of some facilities infrastructure is poor or below standard. Current and future appropriated funding levels are

not expected to increase as facilities age and maintenance costs go up. Funding would be prioritized to accomplish critical health and safety maintenance and deferred maintenance.

Environmental Consequences for Facilities Infrastructure – Alternative 1

Under alternative 1, management of facilities infrastructure would continue under management area-specific goals, objectives, standards, and guidelines in the 1986 Forest Plan (as amended), which was driven primarily by timber harvesting. Alternative 1 provides plan direction to maintain facilities in safe and operable conditions, but does not put an emphasis on sustainable facilities management that manages facilities to standard and considers repurposing or closing facilities that are no longer used as intended or are no longer required to meet Forest Service or user needs. Under current and projected funding levels, the forest cannot adequately maintain all of its facilities; this alternative does not provide management direction that would improve this condition and facilities would likely be under-maintained. The public may feel they are less appreciated or may receive less support from the Forest Service. Unplanned closure of recreation infrastructure could affect the recreation experience of visitors and impact local businesses that rely on Forest Service facilities to draw tourists.

Environmental Consequences for Facilities Infrastructure Common to Alternatives 2, 3, 4, and 5.

Alternatives 2, 3, 4, and 5 include direction to maintain facilities infrastructure to standard. These alternatives do not identify specific facilities but allow for management discretion to determine if a facility would be required to meet the needs of the Forest Service and/or provide meaningful opportunities for the public. As in alternative 1, facilities infrastructure that cannot be effectively maintained or is no longer required would either be repurposed or closed. Decommissioning has the potential to reduce the number of facilities that require maintenance. By investing in only the facilities infrastructure necessary to meet the Forest Service mission, those facilities would be better maintained despite inadequate current and projected funding.

The action alternatives have plan direction to decrease the developed campsite maintenance backlog by 50 to 60 percent over a 10-year period. Achieving this objective would come at the cost of other recreation site or administrative facility maintenance. Currently, the forest cannot maintain all of its facilities to standard. At current funding levels, the forest would not be able to maintain all water systems to standard. Substandard infrastructure such as wastewater systems and dams have the potential to damage and degrade riparian areas, ground and surface water, or other ecological resources. Long term, there could be a loss of economic opportunity for recreational water users and downstream communities who rely upon water from the forest.

Alternatives 2, 3, 4, and 5 all put a greater emphasis on partnering and collaborating with stakeholders who use and rely upon specific facilities infrastructure for both recreation and economic benefit. Working effectively with partners could supplement funding of facilities maintenance and it could reduce the social impact of closing facilities if those closures are done in coordination with the community.

Currently, few developed campgrounds offer group camp sites on the Carson. Alternative 3 includes an objective to convert 25 percent of the single occupancy sites at five existing developed campgrounds from single occupancy to group use. Conversion would potentially increase recreational use of the sites, as group sites are more in demand than single-use sites. Increased use could increase the maintenance requirements for the sites and would further limit resources for other maintenance on the forest. Conversion of developed single-use campground sites to group use could reduce the use of dispersed sites, which currently meet most of the group site demand. Resource damage, such as vegetation trampling, soil disturbance, and increased sedimentation at dispersed sites could be reduced.

Cumulative Environmental Consequences for Facilities Infrastructure

The Carson is adjacent to other public lands, incorporated towns, and many small communities. These downstream communities rely upon the water that flows from the forest. Damage or the failure of key recreation, water treatment, or dam infrastructure could affect water quality or water delivery to downstream communities or agriculture.

Unplanned closure of administrative facilities because of unsafe structures could result in a loss of services to local communities and other forest visitors. Forest users could have to travel to a more distant district office for permits or to address issues with staff. The public may feel they are less appreciated or may receive less support from the Forest Service. Unplanned closure of recreation infrastructure could affect the recreation experience of area visitors and impact business that rely on a facility to draw tourists.

Lands

Description of Affected Environment

Land Ownership

Land ownership is the basic pattern of public and private ownership of surface and subsurface estates. It refers to the ownership of land and interests in land, including any resources and appurtenances included in the conveyance.

Existing Land Ownership

The Carson is located within four northern New Mexico counties: Rio Arriba, Taos, Mora, and Colfax. Table 71 displays land ownership within these counties. Most of the Carson land area lies in Rio Arriba and Taos Counties. The Carson comprises approximately 23 percent of Rio Arriba County and 37 percent of Taos County. Fifty percent of these two counties combined is federally administered. The Carson is the primary holder in both counties. With the combination of Federal, State, and Tribal lands, only 23 percent of Rio Arriba County and 32 percent of Taos County are privately owned. The amount of the Carson within Mora County (1.4 percent) and Colfax County (2.9 percent) is less significant. In Mora County and Colfax County, respectively, 84 percent and 85 percent of the land is privately owned.

The Carson encompasses 1,587,097 total acres, with 1,486,372 acres administered by the Forest Service and 100,725 acres in other ownership within its boundaries. Many of the other ownership areas are small towns or communities, but a large number are small parcels of privately owned land. These land holdings are typically in the lower elevations. Most of the towns and communities are located along rivers or other water sources.

The Carson shares boundaries with other Federal, State, Tribal, and private lands. The BLM's Rio Grande del Norte National Monument resides between the east and west sides of the forest, in both Taos and Rio Arriba counties. BLM also has land that borders the west side of the Jicarilla Ranger District. Four federally recognized tribes have land that borders the Carson: (1) the Jicarilla Apache Nation to the east and south of the Jicarilla Ranger District; (2) the Taos Pueblo, which resides between the Questa and Camino Real Ranger Districts; (3) Picuris Pueblo, which is bounded on three sides by the Camino Real Ranger District; and (4) the Southern Ute Mountain Tribe, north of the Jicarilla Ranger District. To the north, the State of Colorado borders both the Jicarilla and Tres Piedras Ranger Districts. The Tres Piedras Ranger District is also adjacent to the Rio Grande National Forest in Colorado. The Santa Fe National Forest, which occupies 14 percent of Rio Arriba County, shares an extensive border with the Carson along the southern portion of the Canjilon, El Rito, and Camino Real Ranger Districts.

The remaining lands are state and private lands. There are several significant private land holdings within or bordering the Carson. The Village of Taos Ski Valley, the Town of Red River, and the recently closed Chevron Questa Mine reside within the Questa Ranger District. Rio Costilla Park, a privately owned recreation area, resides along the north boundary of the Questa Ranger District. The village of Truchas is surrounded by both Carson and Santa Fe National Forests. In the western zone of the forest, the Petaca Land Grant resides within the Tres Piedras Ranger District. Several communities, Canjilon and El Rito, are within the forest boundary.

Encroachment onto NFS lands is a recurring issue with many of the private land holdings, primarily those inside the forest boundary. Encroachment issues are typically identified when a property adjacent to the forest is sold and a survey is completed.

Table 71. Land ownership (percentages) in the counties that include the Carson

Land ownership	Colfax County	Mora County	Rio Arriba County	Taos County	County Region	U.S.
Privately Owned	85.4	84.3	23.0	32.8	50.2	58.7
Conservation Easement	0	0	0.1	0	0	0.6
Federal Lands	3.2	9.1	52.4	53.9	33.1	28.8
Forest Service	3.0	8.5	37.3	36.6	23.8	8.4
Carson National Forest	2.9	1.4	23.4	36.6	16.8	0
Santa Fe National Forest	0	6.9	14.0	0	6.9	0
Kiowa Grasslands	0.1	0.5	0	0	0.1	0
BLM	0	0.6	15.1	17.3	9.3	11.1
National Park Service	0	0.1	0	0	0	3.4
Military	0	0	0.1	0	0	1.1
Other Federal	0.2	0	0	0	0	4.7
State Lands	11.4	6.5	3.7	5.1	6.4	8.4
State Trust Lands	9.6	5.9	2.3	4.4	5.1	1.9
Other State	1.8	0.6	1.4	0.7	1.3	6.6
Tribal Lands	0	0	20.9	8.2	10.2	4.0
City, County, Other	0	0	0	0	0	0.2

Land Status

Land status is defined as the ownership record of title to lands, including withdrawals, rights, and privileges affecting or influencing the use and management of NFS lands. For NFS lands, land status refers to the use or specific designations of a geographic area that provide general guidance and policy for the management of a defined geographic area. This guidance can take the form of use restrictions (e.g., withdrawals or dedication) and encumbrances (e.g., rights-of-way acquired or granted, reservations, outstanding rights, partial interests, or easements). Land status differs from land ownership. Land ownership refers to the ownership of land and interests in land; whereas, land status refers to the legal character or condition of the land.

Existing Land Status

The Carson was established on November 7, 1906. It was formed by combining the Taos National Forest and a portion of the Jemez National Forest. The original forest comprised 966,000 acres. These lands

were “reserved” from the public domain (land owned by the Federal Government), for the establishment of national forests, giving the lands originally included in the Carson “reserved public domain” status.

Many land ownership adjustments (i.e., exchanges, purchases, and donations) have occurred since the creation of the Carson. In the case of land exchanges, Federal land has been conveyed to the private sector and non-Federal land has been received in exchange. The land so acquired takes on the status of the Federal land conveyed, which in most cases is reserved public domain. Lands that have come into Federal ownership by purchase or donation, have “acquired status” as determined by the Weeks Act Status for Certain Lands Act of September 2, 1958 (16 USC 521a), as amended. Two recent significant land acquisitions were the 100,000-acre Valle Vidal Unit that was donated by the Pennzoil Company to the Forest Service in 1982 and the purchase of the 4,990-acre Miranda Canyon in 2013.

In December 2014, the U.S. Senate passed the Columbine-Hondo Wilderness Act (S. 776/H.R. 1683) as part of the National Defense Authorization Act. Section 3061 designated 45,000 acres of NFS lands in New Mexico as the Columbine-Hondo Wilderness. The Act modified the boundary of the Wheeler Peak Wilderness and provided for the conveyance of several small parcels of NFS lands to the Town of Red River and the Village of Taos Ski Valley.

With the addition of the Columbine-Hondo Wilderness Area, the Carson has six designated wilderness areas, totaling approximately 129,119 acres. Lands that have been designated as wilderness areas are withdrawn from all forms of appropriation under the mining laws and from disposition under all laws pertaining to mineral leasing and all amendments thereto (Wilderness Act of 1964, 16 U.S.C. 1131-1136). A withdrawal is an action that restricts the disposal and use of public lands and which holds them for specific public purposes and programs.

The 1986 Forest Plan identifies 64 parcels of land as withdrawn from mineral entry. These parcels are existing developed recreation sites throughout the Carson. The Carson has since added recreation sites that have also been withdrawn from mineral entry. In December 2006, Congress passed the Valle Vidal Protection Act. The act withdrew Valle Vidal from all forms of mineral entry, with an exception for existing rights.

The Carson has eight administrative sites. Two of these sites are leased and six are owned by the Forest Service. Three of these six sites are on NFS lands and three are located off the Carson. The two leased sites are also outside NFS lands. An administrative site is typically located outside NFS lands and has a special designation that restricts the area to occupation by support buildings and their grounds.

Land Use

Land use is how the land is currently zoned or designated, such as for residential, commercial, industrial, or agricultural use. It includes land use, development, and management policies and direction established in formal plans developed by Federal, State, county, and municipal governments.

Land Special Uses

Land uses are authorized uses and occupancy of NFS lands. These include special use authorizations, such as permits, leases, and easements. Special use authorizations are legal instruments, with terms and conditions that are consistent with law, regulation, and policy and are fully enforceable. The Forest Service divides the management of special uses into two categories: recreation special uses and non-recreation (lands) special uses. The lands special uses program permits water transmission lines, acequias, telecommunication sites, research, filming, and road and utility rights-of-way. The recreation special uses include recreational facilities open to the public, such as resorts and ski areas, as well as services, such as outfitting and guiding and recreation events. Recreation special uses also include private uses, such as recreational residences and organizational camps. Some types of non-recreational special use are nondiscretionary and require the agency to authorize some uses such as access to private inholdings as

required by the Alaska National Interest Lands Conservation Act, Wilderness Act of 1964 (16 U.S.C. 1131-1136), and the National Forest Roads and Trail Act of 1964.

Currently, there are a total of 420 special use authorizations issued on the Carson. Some of these special use authorizations may have expired prior to issuance of this EIS. Of these 420 special use authorizations, 100 are recreation special uses and 320 are lands special uses. Many other temporary uses are not reflected in the total. The Carson issues several permits a year for such things as firewood gathering, filming, for ceremonial purposes, and one-time recreation events.

Most Forest Service special use permits have a term limit. The Carson evaluates long-term land use and recreation special use permits when the terms of the permit are expiring and apply the same criteria for renewal as when the permit was first issued. Currently, the Carson does not anticipate not renewing any specific permits.

Access to Plan Area

Visitor accessibility to the Carson on Federal, State, and county roads from outside the plan area is very good. Within the plan area, 2,600 miles of Forest Service system roads provide access as depicted on the Carson's motor vehicle use maps. Currently, the Carson has issued 92 special use permits to allow access to the many private land holdings within the national forest boundary.

A large component of the lands program is consolidation of the Federal estate within the proclaimed forest boundary to enhance public benefit. The establishment of rights-of-way throughout the forest provides accessibility to both public and private lands within the proclaimed boundary of the national forest. Inholdings are defined as those lands located within proclaimed national forest boundaries that are wholly surrounded and landlocked by Forest Service lands. Inholdings have often been subdivided into smaller parcels, creating literally hundreds of individual parcels of private land.

The Forest Service has a statutory obligation to provide access to private land within the national forest boundary, though this requirement has specific parameters. Within the Carson NF boundaries, the Forest Service is legally obligated to allow physical access to private property that is identified as an inholding but is not required to physically construct infrastructure for access or to absorb the cost of construction. The manner in which access is provided to a private land inholding is at the discretion of line officers based on individual circumstances. Federal laws do not require that the Forest Service authorize access in a manner that would degrade natural resources. For example, if a property has historically been accessed via a riparian area and that manner of access causes resource damage, an alternate means and location of access can be required. Balancing the access needs of private property owners with resource protection is a primary concern, creating a need for standards and guidelines that address how access to private lands is authorized so as to minimize natural resource damage, while also ensuring that the rights of access to private lands are respected. At the same time, some areas are inaccessible by the public because the only access to Federal land is through private property, creating a need for plan direction that encourages the protection of existing public access rights and the acquisition of new access opportunities to the NFS lands.

Environmental Consequences for Lands

Methodology and Analysis

Probable management activities related to alternatives 1, 2, 3, 4, and 5 are used to evaluate or predict short- and/or long-term effects. These management activities are evaluated in relation to their effects on management of Carson NFS lands. To make broad comparisons between alternatives, this programmatic analysis uses:

- The amount and dispersal of proposed recommended wilderness management areas. The resultant impact on desired recreation settings and motorized and non-motorized recreational opportunities vary, depending on how much recommended wilderness is proposed in an alternative.
- Lands guidelines related to inholdings access.
- Lands guidelines related to energy corridors.

Assumptions

Lands are not expected to be a primary driver in selecting one alternative over another, because predicted impacts between alternatives with regard to lands are not dramatically different. Differences between alternatives are small because:

- Lands ownership by the Carson across all alternatives is anticipated and assumed to remain constant.
- All alternatives are expected to achieve desired conditions for lands in the proposed plan.
- All projects implemented on NFS lands on the Carson would require a site-specific analysis of their potential impacts.
- None of the alternatives has specific objectives to exchange or acquire new lands or to grant rights-of-way or easements for a specific purpose during the life of the plan. Proposals would be considered through project-level planning. The environmental consequences of new rights-of-way or easements are identified and analyzed at the project level.
- None of the alternatives prohibit future site-specific project planning.

Environmental Consequences for Lands - Alternative 1

In alternative 1, management of NFS lands would continue under management area-specific goals, objectives, standards, and guidelines in the 1986 Forest Plan (as amended). Alternative 1 has plan language to address the acquisition and/or exchange of other lands as appropriate to provide the most effective management of forest resources. The 1986 Forest Plan references maps in the land ownership adjustment plan that prioritize lands desirable for acquisition. The maps have not been revised to show completed lands adjustments or changing priorities and are no longer relevant. Strict adherence to this list could narrow opportunities to work with local communities in addressing their expansion needs and public access to Federal land or could limit opportunities to acquire properties with high resource value.

Alternative 1 does not address right-of-way easements for inholdings within the Carson. The 1986 Forest Plan has ambiguous language that leaves open to interpretation the number of rights-of-way an individual may have to a property, which has led to, and would continue to require open-ended discussion with property owners. While new roads or utility corridors would benefit private individuals or corporations within the inholding by increasing infrastructure delivering services such as electricity to new areas, the development of new roads or utility corridors has negative ecological impacts including: habitat fragmentation, which increases stress on wildlife and disrupts gene flow; altered vegetation, which can lead to soil and water cycle disruption, soil compaction and erosion, and degraded water quality; and noise pollution. The addition of new utility corridors could also increase the risk of uncharacteristic fire, as many fires are ignited by trees falling against powerlines, leading to a host of negative ecological effects like increased erosion, flooding potential, and vegetation removal. The need to acquire rights-of-way across State and private property is still a concern. As ownership patterns change within the boundaries of the forest, access to national forest-managed lands would remain an issue.

Alternative 1 addresses that rights-of-way should be provided for utility corridors and all utility services should be concentrated within the corridors to reduce the impacts to ecological resources. This plan language does not limit the ability to develop new corridors, as long as utility services fall within a

corridor. Alternative 1 has no areas recommended as potential wilderness or management areas that may restrict new roads or utility corridors.

Environmental Consequences for Lands - Alternatives 2, 3, 4, and 5

The effects to lands would be the same across alternatives 2, 3, 4, and 5. The action alternatives have plan language to add forested lands, similar to alternative 1. But unlike no action, the other alternatives do not map specific locations but leave open the option to consider any lands that may become available that could improve management toward desired conditions for ecological resources, recreation, and scenery. The action alternatives also have plan language to consider acquiring land opportunities that can improve the ability to contribute to long-term social and economic opportunities for local communities. Considering land opportunities as they become available, rather than identifying specific lands the forest would like to acquire, would improve the forest's flexibility to make decisions about which available lands could contribute to improved management of forest resources as ecological and social economic conditions change. Evaluating available lands when the opportunity arises provides flexibility to evaluate if available land might be better within a local land grant or county to contribute to socioeconomic opportunity. Meeting the needs of local communities would reduce user conflicts and enhance satisfaction in public ownership of NFS lands.

Under the action alternatives, there would be continued efforts to consolidate land ownership within the forest boundary and establish new rights-of-way, where needed, to benefit both private landowners and Federal land management. The purchase of small isolated inholdings within the forest would simplify management activities and streamline public access. The need to acquire rights-of-way for road and trail access would be reduced with a more consolidated land pattern. Having a continuous land base has ecological benefits such as providing quality wildlife habitat and connectivity of travel corridors, protecting at-risk species, and maintaining naturally appearing landscapes

The action alternatives address inholding right-of-way easements and establish, through a guideline, that only one access route should be allowed per private property inholding. This plan language should make it clearer to purchasers of private property inholdings that not all existing access routes would be allowed and emphasize the need to work with the Forest Service to resolve issues before they become a legal disagreement. Clear direction regarding the number of allowed routes would result in fewer access routes that could negatively impact ecological resources.

The action alternatives have additional plan guidance to manage utility transmission and distribution corridors. The alternatives have plan language to maximize existing utility corridors prior to considering new corridors. The Carson extends over 1.4 million acres in northern New Mexico. Major utilities have considered moving power from east to west across the Carson and the potential for new power lines across the forest does exist. Standards and guidelines requiring maximization of existing rights-of-way and infrastructure would consolidate needed infrastructure in areas that already have such infrastructure present. Consolidation of services would alleviate impacts to and minimize the amount of land necessary to support this infrastructure.

Alternative 2 has 9,189 acres of proposed recommended wilderness, alternative 3 has 0 acres, alternative 4 has 45,473 acres, and alternative 5 has 67,996 acres. To maintain the wilderness characteristic of these areas, no new roads would be constructed. The Carson has several small communities and several private inholdings, all of which have access through forest lands either on a non-forest system road or a permitted easement. In the event an alternative route would be required, no access would be allowed in these proposed recommended wilderness areas, even if it is the best available alternative route. The potential for this occurrence is unlikely, so the impact for access to other lands within the forest is minor.

Cumulative Environmental Consequences for Lands

Cumulative environmental consequences are spatially bounded by an area larger than the Carson NF's proclaimed boundary. While there is minimal to no population growth in the state, some areas around the national forest have seen recent development. Also, many areas in northern New Mexico are likely to install additional infrastructure in the future (e.g., natural gas distribution, high-speed internet). Power transmission to areas west of the Carson continues to be in demand as southwestern populations grow and more energy is required to support them. Most of the far western state of California has been declared a national priority site for electrical energy supply. Emerging energy markets from states to the east of New Mexico are likely to fill that need. Sources of wind and solar energy power in midwestern states could potentially look to areas in northern New Mexico as distribution routes. The Carson, Santa Fe, and Rio Grande NFs are likely locations for new east-west power transmission, raising the potential for utility corridor requests in the future. Much of the existing energy infrastructure is aging and may need replacing or upgrading. The local utility, Kit Carson Electric, has committed to providing 100 percent solar power to all of its customers. As it decentralizes its power generation, new or upgraded transmission lines may be required.

The Carson NF sits within Colfax, Mora, Rio Arriba, and Taos Counties in northern New Mexico. Other Federal lands in northern New Mexico include the Santa Fe NF and BLM's Rio Grande del Norte National Monument. These Federal entities take up more than 50 percent of both Taos and Rio Arriba Counties. Land available for expanded development is limited. Continued population growth in surrounding communities and in the Southwest is expected, which would add to the demand for additional lands for development purposes, especially infrastructure. Communities that have not planned for additional infrastructure needs would likely request acquisition of NFS lands for infrastructure.

As private properties, especially inholdings change from rural or undeveloped land to subdivisions or higher density uses, encroachment into NFS land becomes more frequent, resulting in resource impacts and land survey needs. As communities grow and infill occurs, undeveloped lands and their open space values are converted to residential or commercial uses. This growth would likely result in continued pressures to maintain NFS lands for their open space values. As further development occurs, residential encroachments onto the national forest are expected to occur more frequently and degrade wildland character and other resource values. Working with other governmental partners on ordinances and plans could continue to reduce potential impacts to forest resources.

There are communication sites scattered across much of northern New Mexico. The mountain ranges that run the length of the Carson act as communications barriers and separate many of these other lands. As infrastructure ages and new communication technologies emerge, the potential for requests for new sites and infrastructure may increase.

Local collaboration expectations with communities and their desire for open space may result in localized exchanges. However, all alternatives acknowledge community needs and the locations where land adjustments are appropriate and minimize impacts to other resources. As such, these cumulative effects would be consistent among all alternatives.

Special Uses

Section 1502.2(b) of the National Environmental Policy Act provides for discussion of impacts in proportion to their significance. The environmental consequences in this section focus on the components of special uses that are useful to the decisionmaker and the public.

Land occupancy and use by private parties and other government entities is managed through the issuance of special-use authorizations. Authorized special uses on the Carson include industrial or commercial uses, private uses, and a variety of recreational uses. All occupancy, use, or improvements on NFS lands

that are not directly related to timber harvest, grazing, mining activities, and recreation are referred to as “non-recreation lands special uses.” Typically, non-recreation special uses include roads, utilities, storage facilities, communications sites, research, and commercial filming. Recreation special uses include resorts, ski areas, outfitters and guides, and a variety of uses that provide access to NFS lands through commercial ventures. Use and occupancy of NFS lands may be authorized when such use is determined to be in the public interest.

Description of Affected Environment

Some uses of NFS lands are covered by special-use authorizations, including permits, leases, and easements that allow occupancy, use, rights, or privileges on the Carson National Forest. Special-use authorizations are legal instruments whose terms and conditions are fully enforceable when consistent with laws, regulations, and policies. The mission of the Forest Service’s Special Use Program is to manage the use and occupancy of NFS lands in a manner that protects natural resource values, promotes public health and safety, and is consistent with the plan.

The Carson currently administers 595 issued special-use permits, of which approximately 202 are categorized as recreation permits and 393 as lands permits. Recreation permits range from outfitter/guide permits to developed ski areas and other resorts. There are four developed ski areas under permit on the national forest: Taos Ski Valley, Red River Ski and Summer Area, Enchanted Forest Cross Country Ski Area, and Sipapu Ski and Summer Resort.

Lands special uses range from permits for individuals to use NFS land for their driveways to more extensive uses such as power lines, fiber optic cable, telephone lines, and oil and gas pipelines that may traverse many miles of NFS lands. Other land uses under permits include communications towers and research studies.

Authorizations may be short-term, such as for recreation events or noncommercial group uses, or longer-term such as resorts and communications uses. National emphasis on energy development and transmission is expected to grow, as are communication use site proposals. Requests for use of Federal lands for communication use sites are predicted to increase in the future as the population grows and new technologies emerge. Requests to use Federal lands for utilities transmission and energy development are also predicted to increase due to higher demand.

Special Uses Trends

Requests will likely increase in the future for special use activities such as utilities, roads, and digital communication connections, which will be addressed on a case-by-case basis following applicable Forest Service laws, regulations, and policies. Mitigations will be addressed using approved appropriate techniques such as consolidating new developments along existing routes and corridors and construction methods that disturb less land and improve reclamation success.

Environmental Consequences for Special Uses

Methodology and Analysis Process

The number of special-use authorizations currently in effect were compared to potential changes that might result from implementing any of the alternatives considered.

Assumptions

Special uses are not expected to be a primary driver in selecting one alternative over another, because predicted impacts between alternatives from special uses are not dramatically different. Differences between alternatives are small because:

- All alternatives are expected to achieve desired conditions for special uses.
- All projects implemented on the forest will require a site-specific analysis of their potential impacts to and from special uses.
- Special-use permits across all alternatives are anticipated and assumed to remain at constant levels or increase moderately based on demand.

Environmental Consequences for Special Uses - Alternative 1

This alternative reflects the 1986 Forest Plan, as amended, and accounts for current laws and regulations that have been issued since the original forest plan and the amendments were adopted. The number of special-use permits, rights-of-way, and easements would not be impacted by a change in access¹⁹ or any change in land use under this alternative.

Environmental Consequences for Special Uses- Alternatives 2, 4, and 5

Some management areas, such as recommended wilderness, the San Antonio Management Area, and the Valle Vidal Management Area are allocations that could impact the number and types of special uses that would be permitted. Some special-use authorizations (such as power lines, communication towers, commercial filming, etc.) would be less likely to be granted in these management areas, especially recommended wilderness. Based on recommended wilderness management area allocations, alternative 5 would have the greatest number of acres less likely to be considered for these types of special-use authorizations, followed by alternative 4, and alternative 2.

Environmental Consequences for Special Uses- Alternative 3

The Off-Highway Vehicle Management Area may increase the number of special-use permits granted under alternative 3. This management area would likely result in an increase in motorized competition special-use permits. Alternative 3 does not recommend any wilderness and does not include the Valle Vidal or San Antonio Management Areas. Therefore, this alternative would be most likely to increase the number of special-use permits on the national forest.

Cumulative Environmental Consequences for Special Uses

Cumulative effects evaluate the potential impacts to NFS lands and special uses from the proposed action when combined with past, present, and reasonably foreseeable actions. The lands within the Carson NF boundary form the geographic scope for cumulative effects because this is the scope for the analysis. The temporal bounds are the life of the plan, which is estimated to be 15 years.

In order to integrate the contributions of past actions and the cumulative effects of the proposed action and alternatives, existing conditions are used as a proxy for the impacts of past actions. Existing conditions reflect the collective impact of all prior actions that have affected special uses and may contribute to cumulative effects. Special uses can be expected to be influenced by a variety of factors.

The Carson NF can expect requests for special-use authorizations to increase in the future. As more private land is developed, there is usually an associated increase in requests for special-use authorizations such as road and utilities. Requests for modification of existing authorized communications sites and designation of new communications sites can reasonably be expected as technological advances (e.g., cell phones) occur. On the national forest, these sites typically occupy small areas (1 to 2 acres).

Boundary surveying and marking will continue, and encroachments are likely to be discovered.

¹⁹ In this section, access refers to the legal rights-of-way acquired by the Forest Service across non-NFS land for the management and use of NFS lands.

Wildland Fire Management

Description of Affected Environment

Wildland fire includes both wildfire (unplanned ignitions) and prescribed fire (planned ignitions). Fire management includes strategies and actions employed in preparation for, and during wildland fire. Some preparations for wildfire involve manipulation of vegetation or fuel management, to change the characteristics of a fire when it burns. Fuel management may include prescribed fire or mechanical treatments that change the amount, configuration, and spacing of live and dead vegetation, creating conditions that favor more manageable fire behavior and reduced wildfire severity.

All wildfires are managed by the Forest Service on a continuum between meeting protection objectives and meeting resource objectives based on the fire's location and the burning conditions. Response to a specific fire is dependent on plan direction, mainly in the form of desired conditions, and on burning conditions that change throughout the season and year to year. Forest Service policy requires every wildfire response to include some level of protection as an objective. This can vary from monitoring the fire when conditions are conducive to producing resource benefits, to aggressive suppression objectives to protect communities or resources from potential damage.

The interagency National Cohesive Wildland Fire Management Strategy “recognizes and accepts fire as a natural process necessary for the maintenance of many ecosystems and strives to reduce conflicts between fire-prone landscapes and people.” (USDA and USDI 2014). Three primary national goals complement each other in a holistic approach to fire management. The first is that landscapes are resilient to fire-related disturbance. This includes restoration of fire on the landscape and restoration of fuel conditions that support natural fire regimes. The second goal is that communities are fire-adapted. This means preventing the loss of life and property, but also that communities accept fire as a necessary process in wildlands. Finally, the response to wildfire is safe, effective, and efficient, with decisions based on a process of sound risk management (USDA and USDI 2014).

The wildland-urban interface is the matrix where structures or other human development meet and intermingle with wildland fuels that carry fire when conditions permit. Although a wide variety of fire management strategies are available in the wildland-urban interface, these options are usually more limited than elsewhere on the forest due to heightened concerns for values at risk. Fire management in the wildland-urban interface focuses on suppression and modifying fire behavior to minimize crown fire potential, decrease fire intensity, and/or decrease rate of spread to aid fire suppression activities.

Current conditions of many Carson forested lands support fire regimes that are departed from historic and desired conditions, increase the risk of uncharacteristically severe fires, threaten communities and infrastructure, and make fire management less effective and more dangerous. In all but the highest elevation systems, over 100 years of fire suppression has altered the fire regime to some degree. Most ecosystems have missed at least some fire that would have occurred naturally, and frequent fire systems have missed many cycles. Forest structure and species composition are altered as a result and the functions that fire provides, including fuels removal, regeneration, creating mosaic conditions, and nutrient cycling, are lacking. The frequency of large wildfires and fire season length have increased substantially since 1985 (Westerling et al. 2006), linked closely to earlier spring snowmelt and increases in spring and summer air temperatures. Earlier spring snowmelt probably contributes to greater wildfire frequency in at least two ways, by extending the period during which ignitions may potentially occur and by reducing water availability to ecosystems in mid-summer before the onset of summer monsoons, thus enhancing drying of vegetation and surface fuels (Westerling et al. 2006).

Environmental Consequences for Wildland Fire Management

Methodology and Analysis

The wildland fire continuum (figure 21) is a tool for visualizing the relationship between protection objectives and resource objectives (Thompson et al. 2016). Wildland fire management approaches may be located along vertical and horizontal axes according to their location and conditions under which they burn. The horizontal axis reflects the desire for fire on the landscape; on the left, location favors protection of values at risk, on the right location favors resource benefits of fire. The vertical axis represents social, ecological, or environmental conditions affecting the temporal desirability of fire. Diagonal shading represents the range of objectives. Red (upper left) represents conditions and landscapes that favor protection as the dominant objective. Green (lower right) represents low-risk conditions and landscapes that allow managing for resource benefits to become the primary objective.

Alternatives are located within the continuum, with alternative 3 in the upper left where conditions and landscapes favor protection as the dominant objective, and alternative 4 in the lower right, which represents low-risk conditions and landscapes that allow managing for resource benefits. Alternatives 1 and 2 are in the middle of the continuum, and alternative 5 is positioned closer to alternative 4.

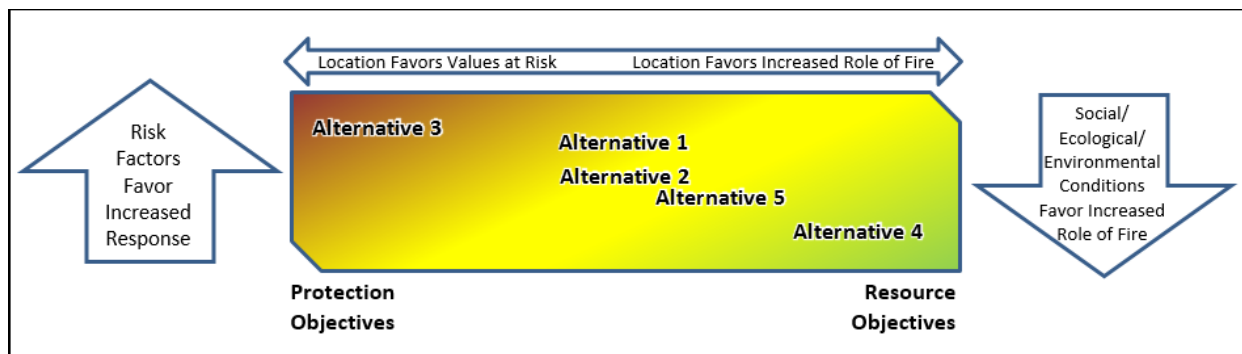


Figure 21. The wildland fire continuum

Every wildland fire, or portion of a fire, fits on the continuum, with its position shifting in time as it moves across the landscape and external conditions change. However, the suite of desired conditions in each plan alternative favor fires in certain parts of in the continuum. The central tendency for each alternative is indicated on the continuum in figure 21 based on the objectives and the likely level of response for each alternative. Alternative locations are relative and reflect the most likely fire management approach, based on plan components. Fire under any alternative may be managed with a full range of approaches.

Indicators

Ability to manage fire for ecological benefit

Fire is part of the natural disturbance regime in most vegetation communities on the Carson. It is characterized by a typical severity and frequency depending on specific site characteristics. Fires that burn with atypical severity and/or frequency can have negative ecological impacts, particularly in historically frequent, low-severity fire systems like ponderosa pine and dry mixed conifer. Departed conditions, such as overly dense forests or lack of grass cover, make managing fire for desired outcomes more difficult. Human uses and values impose additional restrictions on fire management. For example, the public's tolerance for smoke and burned viewsheds, the need to protect water sources, and the tradeoff

between closing burned areas for safety concerns and allowing use all may limit the ability to let fires play an ecological role.

Ability to manage fire to protect life, property, and other values at risk

The ability to manage fire to protect resource values at risk is related to both the restoration of fire-prone vegetation communities to make fire more manageable and preparation of values themselves to make them more protectable.

Ability to manage fire safely

The first objective of all wildland fire management is safety of firefighters and the public. Fire management is safest when resources and tactical options are available to managers. High-intensity, fast moving fire is more dangerous to manage and reducing its likelihood by restoring fuels that carry low-intensity fire, where appropriate, improves safety for managers and the public. In areas where firefighter safety is a concern, such as in the wildland-urban interface, managing fuels for desired fire behavior rather than desired ecological condition may be preferable.

Assumptions

- Wildfire will continue to be more severe and frequent than it has been historically due to increasing temperatures, longer fire seasons, and likelihood of drought (Westerling et al. 2006).
- The location of wildland-urban interface will shift over time and continue to expand as the number of homes and other infrastructure adjacent to and surrounded by wildlands continue to increase.

Environmental Consequences for Wildland Fire Management Common to All Alternatives

The key role that fire plays in maintaining ecosystem diversity is recognized in the old plan (alternative 1) and in all action alternatives. Fire will be a disturbance in the future, even in alternative 3, where its extent is more limited. Under all alternatives, fire would provide desired ecological functions in some places, and it would have undesired consequences in others due to fuel conditions, environmental conditions, a combination of fuels and environmental conditions, or negative impacts to values at risk.

Under warmer and drier climatic conditions, the potential for wildfire would increase as fire seasons lengthen, vegetation water stress increases, and warmer temperatures become more common. Fire intensity and severity would likely be higher as well because of more extreme (hotter and drier) fire weather and higher fuel loadings from, for example, tree mortality and existing high forest densities. The cost of fire suppression is expected to remain high, if not increase, and would be compounded by continued population growth, and expansion of the wildland-urban interface.

Smoke would be a byproduct of prescribed burns and wildfires under all alternatives. While all alternatives are expected to meet desired conditions for air quality by complying with State and Federal emissions regulations, the public tolerance for smoke is often reached long before health and visibility standards are exceeded.

The location of the wildland-urban interface is not mapped for any of the alternatives. Its location is likely to shift in the future as development increases, oil and gas production and development continues within the Jicarilla Natural Gas Management Area, and patterns change. Management actions in the wildland-urban interface would be similar under all alternatives, though alternative 1 does not describe specific fuel conditions that would be desired. Fire behavior would be modified through mechanical treatment in the wildland-urban interface under all alternatives to reduce threats to values at risk and improve firefighting effectiveness. Most fires in the wildland-urban interface would be suppressed at the smallest size possible,

though it may be desirable to steer fires from the wildland-urban interface into adjacent wildlands under favorable conditions.

The alternatives do not differ regarding the desired amount of wildland-urban interface treatment, though it can be assumed that in alternatives with more mechanical treatment overall, some of that additional treatment would occur in the wildland-urban interface. Some treatments are likely to result in more open stand conditions with fewer snags and less coarse woody debris compared to the surrounding forest under all action alternatives (FW-VEG-SFF-DC-14, FW-VEG-MCW-DC-14, FW-VEG-MCD-DC-15, FW-VEG-PPF-DC-14, FW-VEG-PJO-DC-12, and FW-VEG-DC-PJS-DC-12). However, in other parts of the wildland-urban interface, managing toward general desired conditions would also lower fire risk to acceptable levels. That is, while some treatments in the wildland-urban interface would look different than restoration treatments elsewhere, not all would. Under alternative 1, treatments in the wildland-urban interface would have similar results, based on the best available science for reducing fire intensity and assisting in the control of fire.

While the wildland-urban interface is not mapped on the Carson NF and no specific projects are proposed under this plan, the extent of possible impacts of managing fuels to lower fire risk can be estimated for these areas. Haas, Calkin, and Thompson (2013) have mapped wildland-urban interface nationwide by distributing census block population data based on the likelihood of areas being populated. They use LandScan USA data that downscales census block population information to model the location of residential population. Areas were mapped as wildland-urban interface when a residential population overlapped with a flammable fuel category according to the LANDFIRE Fire Behavior Fuel Model 40 layer. The resulting map is not accurate at a project level and does not correspond to specific areas where plan components would be applied. It is useful at a forestwide level to compare patterns of fuel flammability, population distribution, simulated fire ignition and growth, and vegetation communities defined under the final plan.

Figure 22 shows fire risk in mapped wildland-urban interface on the Carson NF by vegetation community. The risk ratings are unitless and range from -7 to 0, with smaller values indicating higher risk. More aggressive treatments that look less like restoration treatments would be most likely to be implemented in higher risk areas. Treatments in lower risk areas would be more likely to look like restoration treatments elsewhere on the Carson NF. Most of the wildland-urban interface occurs in just two vegetation communities—ponderosa pine forest and piñon-juniper sagebrush. Fewer total acres are in the mixed conifer-frequent fire vegetation community, but a large portion of those acres are at higher risk of wildfire.

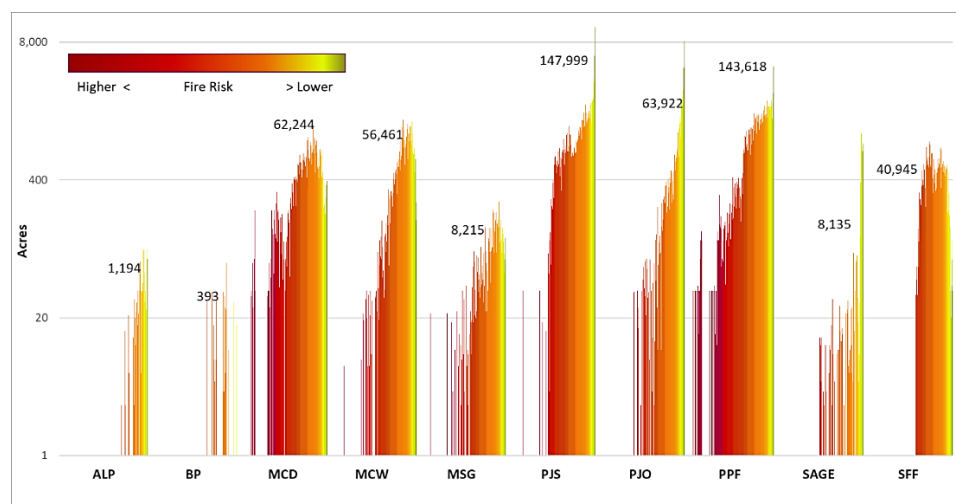


Figure 22. Fire risk distribution in the wildland-urban interface by ecological response unit on the Carson NF

Each distribution ranges from -7 to 0 with lower values indicating higher fire risk. Numbers above each distribution indicate the total acres of wildland-urban interface by ecological response unit. The vertical axis is logarithmic.

A large percentage of the piñon-juniper sagebrush vegetation community is mapped as wildland-urban interface, but very little (69 acres) is at very high fire risk (see figure 23). Five vegetation communities have more than one-third of their area mapped as wildland-urban interface, but fire risk is high or very high in more than 2 percent for just three—mixed conifer-frequent fire, ponderosa pine, and piñon-juniper sagebrush (figure 23). In total, there are about 50,000 acres of high and very high-risk wildland-urban interface across all vegetation communities on the Carson NF where more open stand conditions with fewer snags and less coarse woody debris are most likely to be the desired condition. The exact location of these conditions has not been determined, not all these acres are likely to be treated under any alternative over the life of the plan, and not all treatments in these areas would be different than treatment in other areas.

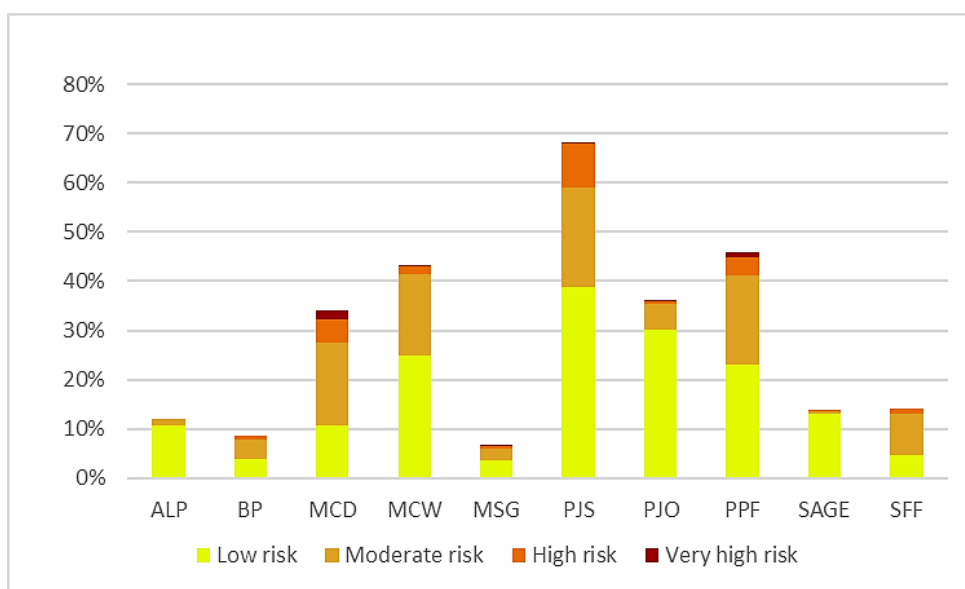


Figure 23. Percentage of each ecological response unit mapped as wildland-urban interface, by fire risk

Environmental Consequences for Wildland Fire Management – Alternative 1

There is direction in the existing plan to allow fire, as closely as possible, to function in its natural ecological role. This, however, is not well defined. The use of fire for resource benefit is encouraged, while also protecting property and the safety of the public. There is a lack of vegetation community-specific desired conditions related to fire regimes, vegetation structure, and composition. This would allow a wide range of fuels and fire management options that do not necessarily restore desired ecosystem functions. For example, low-severity prescribed fire in characteristically mixed-severity systems does not achieve characteristic patch mosaic or structural diversity. There is also not clear direction related to fuels treatment in wildland-urban interface areas. There are no objectives related to fire or fuels treatment, and management practices would continue at current rates, resulting in fire on the landscape at levels far below the historic range. Related vegetation effects would continue, including fewer fire created openings, suppressed understory response, less aspen regeneration, and overabundance of fire sensitive species such as white fir. Many fires would burn under undesirable conditions and would more likely be managed for protection objectives. Fires that burn in departed, overly-dense, frequent fire forests are likely to have uncharacteristically high severity and negative environmental impacts including soil damage, loss of large overstory trees, and wildlife habitat loss.

Effects Environmental Consequences for Wildland Fire Management Common to Alternatives 2, 3, 4, and 5

Under all action alternatives, management of fire would be focused on protecting life, property, and cultural and ecological resources while encouraging the natural role of fires that burn within the range of severity and frequency of historic fire regimes. There is direction to adjust the response to wildfire in time and space, based on a risk management approach, while accomplishing integrated resource objectives. Managed fires would have more characteristic effects in vegetation communities that are closer to their desired structure and composition, particularly in frequent fire forests. The action alternatives define the wildland-urban interface, though its delineation is project specific. All action alternatives provide direction specific to each vegetation community to manage for wildland-urban interface fuel conditions that would facilitate effective fire management.

Fire would be more common under all action alternatives than in alternative 1. More fire across the landscape would result in more fire-created openings, increased understory response, more aspen regeneration, and a reduction in the overabundance of fire sensitive species such as white fir.

Environmental Consequences for Wildland Fire Management – Alternative 2

Mechanical treatments would be applied to reduce fire behavior in areas where values at risk are a concern (e.g., wildland-urban interface) or in areas that would otherwise make fire management on the landscape more effective (e.g., creating fuel breaks, downwind buffers). Fire would be desired in more locations than in alternative 3, where it is limited near trails and in suitable timber. Fire would be desired under more environmental conditions than in alternative 4, where mechanical preparation is limited, and ecological conditions are less likely to favor resource objectives. Therefore, alternative 2 would allow fire as a process, with associated ecological benefits, across more acres than any other alternative. Regenerative and nutrient-cycling processes would be increased. Wildlife habitat would be improved. Threats to values at risk and risks to fire management personnel and the public would be reduced.

Environmental Consequences for Wildland Fire Management – Alternative 3

Fire would be infrequent in some areas, including suitable timber and near trails, where it would generally be suppressed according to FW-FIRE-G-1. Outside those areas, it would be more frequent than under any other alternative, but in suitable timber and near trails the ecological benefits of fire would be less than under alternative 1. Tree densities would remain uncharacteristically high, nutrient cycling would be reduced, and habitat quality may be degraded in these areas. Wildfire management would be more effective in areas where stand-structure and species composition had been mechanically altered, but in large areas of frequent-fire forests uncharacteristically severe wildfire would be likely and fire management would be more difficult. Fire behavior could be reduced in wildland-urban interface areas through mechanical treatment and values at risk would be protected. Planned prescribed fire may be implemented less than under other alternatives as fire management cost savings would be needed to offset the increased recreational focus under this alternative.

Environmental Consequences for Wildland Fire Management – Alternative 4

In alternative 4, the small amount of mechanical treatment that would occur would focus on treating fuels to protect communities and wildland-urban interface areas, but fire management would be difficult and costly as fires would burn with uncharacteristic intensities in many frequent-fire forest areas. In those areas, fire effects would be more likely to result in loss of canopy cover and negative soil impacts than under alternative 2. In other forest and woodland types, fire effects and management would be similar to those in alternative 2.

Environmental Consequences for Wildland Fire Management - Alternative 5

Alternative 5 adds 57,314 acres of recommended wilderness to alternative 2. Much of that additional acreage (23,202 acres) is in high-elevation forest types where wilderness recommendation would have little effect on fire effects or management. There are 31,894 acres in frequent-fire forest, grassland and woodland types where wilderness regulations would change fire and fuels management significantly. Wildfires would be more likely to burn with uncharacteristically high severity, particularly in the 11,839 acres of frequent-fire forests, and may pose a risk to adjacent infrastructure or communities, including McCrystal Place, Shuree Lodge, Santa Barbara Campground, Los Pinos Campground, Los Pinos State Recreation Area, and adjacent private land.

Cumulative Environmental Consequences for Wildland Fire Management

Most Federal and State landowners recognize the importance of pre-fire fuels treatment and restoration, and there is growing public support for prescribed fire and unplanned ignitions managed for resource benefit. There are more than two dozen Firewise communities in northern New Mexico and southern Colorado. The expansion of housing and other infrastructure into forested and other fire-prone locations would continue in the future, expanding and complicating fire management in the wildland-urban interface. When wildfires threaten large-scale destruction of private property, millions of dollars are spent defending these private lands and property, and additional pressure is placed on forest management to accommodate the rebuilding process, including road and other infrastructure reconstruction, after damage occurs.

Multijurisdictional reintroduction of fire and fires that are allowed to burn in more natural patterns across administrative boundaries would improve landscape-scale effects. For example, vegetation patchiness and habitat connectivity would be improved. The risk of escape is lower when natural or advantageous barriers are used as fire breaks rather than ownership boundaries. Watershed function is improved when watersheds are treated more holistically. Smoke impacts originating from the Carson are likely to increase in duration as shoulder-season burning increases, while higher-intensity smoke impacts from large summer wildfires would continue to impact locations intermittently and unpredictably. During many fire seasons, smoke that impacts the Carson NF and northern New Mexico may have traveled long distances. Smoke impacts are often unrelated to Carson NF management, but are dependent on year-to-year variation in regional wildfire activity and may originate from many states away. Public tolerance for smoke is often reached long before health and visibility standards are exceeded and the public response to burning may limit opportunities to use it as a management tool.

Minerals and Mining

Description of Affected Environment

The Forest Service recognizes the importance of NFS mineral resources and energy production to the well-being of the Nation and encourages bona fide mineral and energy exploration and development. But it also recognizes its responsibility to protect the surface resources of the NFS lands under its care. Thus, the Forest Service is faced with a double task: to make minerals and other energy resources from NFS lands available to the national economy, and at the same time, minimize the adverse impacts of those activities on other resources.

The Forest Service, itself, generally does not initiate exploration or development of mineral resources. Rather, proposals for access to, exploration for, and development of mineral resources are driven by external parties and market forces. As they are received and determined to be ready for consideration, individual proposals are evaluated on a site-specific basis and mitigated individually under a separate environmental analysis that follows Forest Service policy regarding the approval of mineral plans of

operation. Operations on the forest are required to be conducted to minimize adverse environmental impacts to NFS surface resources. Minerals-related proposals require site-specific analysis to evaluate compliance with applicable laws, regulations, and with the plan.

Public domain lands on the Carson are available for exploration, development, and extraction of mineral resources except where lands have been withdrawn from mineral entry and discovery of a valuable mineral was not made prior to the withdrawal. Mineral exploration, mining activity, and other mineral activity on the Carson is separated into three federally recognized legal and regulatory mineral categories, locatable, salable, and leasable minerals.

Locatable minerals are those that may be located with a mining claim under the General Mining Law of 1872, as amended (30 U.S.C. 22, et seq). Locatable mineral deposits include, but are not limited to, most metallic mineral deposits and certain nonmetallic and industrial minerals such as gold, silver, copper, lead, zinc, platinum, precious gems, uranium, bentonite, and chemical grade limestone. No active, locatable, mineral mines occur on the Carson, although uranium deposits do exist and the national forest has two inactive uranium mines. The forest contains numerous abandoned gold and silver mines. Several streams on the forest are used for recreational gold panning. There are known rare-earth deposits on the forest.

Also known as mineral materials, saleable minerals include sand and gravel, decorative stones, and clay. The forest provides opportunities for the public to harvest these products from designated areas. The current level of use of these materials is such that existing sites can remain functional over an extended time.

The only leasable materials currently administered on the Carson are oil and gas. Oil and natural gas development on the Carson is limited to the Jicarilla Ranger District. The Jicarilla Natural Gas Management Area (JICMA) covers the entire ranger district, and leasing is authorized everywhere except the 640-acre Gasbuggy Site. Located on the eastern edge of the San Juan Basin, the area is the most productive coalbed methane region in North America and mineral lease development and production have occurred on the Jicarilla Ranger District for over 65 years.

As of February 2019, there were 791 active wells and over 200 plugged and abandoned wells on the Jicarilla Ranger District. Since 2015, 115 wells have been approved and 4 wells have been drilled. In the last 4 years, 11 wells have been plugged. Those numbers were similar in the previous 4-year period between 2012 and 2015, when 3 wells were drilled and 20 were plugged. Royalties generated from mineral leases average nearly \$30 million per year, but fluctuate by as much as 30 percent or more, year to year. As part of oil and gas development, an extensive pipeline system of around 450 miles collects natural gas from individual wells on the Jicarilla Ranger District and surrounding areas and transports it off-forest for processing. The majority of this system is aging, and a considerable amount of annual maintenance is required.

Coal exists under the Carson in Valle Vidal on the Questa Ranger District. The coal rights are owned by the Pennzoil Company. There is no indication that Pennzoil has any interest in excavating the coal.

Renewable energy sources on the Carson are limited to solar and geothermal energy. The national forest has no water resource that could support hydropower development and, due to terrain and accessibility issues, the forest is considered to have low wind power potential. However, there is good potential to provide solar and geothermal power as sources of renewable energy. No existing renewable energy sources have been developed on the Carson for commercial use.

Environmental Consequences for Minerals and Mining

Methodology and Analysis

Probable management activities related to alternatives 1, 2, 3, 4, and 5 are used to evaluate or predict short- and/or long-term effects to mining and minerals on the Carson. These management activities are evaluated in relation to their effects on reclamation of mining activities, new mining claims, common minerals, and energy development. To make broad comparisons between alternatives, this programmatic analysis uses:

- The amount and dispersal of proposed recommended wilderness management areas. The resulting impacts on desired recreation settings and motorized and non-motorized recreational opportunities vary, depending on how much recommended wilderness is proposed in an alternative.
- Mining standards related to reclamation activities.
- Mining desired conditions related to renewable energy sources.
- Plan components related to recreation for the proposed San Antonio (alternatives 2 and 4), Valle Vidal (alternatives 2 and 4), and Wetland Jewels (alternative 4) Management Areas.
- Leasable minerals including oil and natural gas are disposed of through leases issued by the Bureau of Land Management after the Carson has provided appropriate stipulations. Development can only occur after site-specific NEPA analysis for each proposed development. No leasing decisions are being made as part of this forest plan revision.

Assumptions

Minerals and mining are not expected to be a primary driver in selecting one alternative over another, because predicted impacts between alternatives are not dramatically different. Differences between alternatives are small because:

- Mineral, mining, and energy development across all alternatives are anticipated and assumed to remain constant.
- All alternatives are expected to achieve desired conditions for minerals and mining in the proposed plan.
- All projects implemented on the forest require a site-specific analysis of their potential impacts to minerals and mining and verification of the need for mitigation to meet desired conditions.
- None of the alternatives has specific objectives to construct new energy infrastructure or develop areas for mining or energy during the life of the plan. Proposals would be considered through project-level planning. The environmental consequences of mining and energy development are identified and analyzed at the project level.
- None of the alternatives prohibits future site-specific mineral and mining project planning.

Environmental Consequences for Minerals and Mining Common to All Alternatives

Under all alternatives, management of minerals and mining, including in the Jicarilla Natural Gas Management Area, would comply with applicable laws and regulations, and in doing so, minimize impacts to other resources. There is plan direction to conduct mineral and mining activities in a manner that minimizes any adverse impact to ecological and cultural resources.

Under all alternatives, leasable mineral activities may have adverse environmental consequences on some resources in the short term and long term. Short-term environmental consequences could include

increased human activity, such as motorized traffic, noise from drilling equipment, temporary roads, ground disturbance during drilling activities, and construction of authorized well pads, or pipelines. Long-term environmental consequences could include impacts from operation and maintenance of the authorized facilities over the life of the facility. Operation and maintenance impacts may include increased human activity and noise, motorized vehicle traffic, or additional ground disturbance.

Standards and guidelines requiring mitigation measures lessen these environmental consequences by protecting resources affected by mineral operations, including specific standards to ensure reclamation to stable, productive conditions, consistent with forestwide desired conditions.

Stipulations on new leases may affect a company's ability to access the surface to drill a well. Minerals may be less accessible or more costly to access, which may make development uneconomical. Over the long term, the general public and local communities would benefit from services provided by mineral activities. The potential benefits of mineral activities include having domestic (e.g., not foreign) sources of oil and natural gas to increase national energy security, local employment, royalties paid on the minerals support Federal and State programs, and State and county taxes paid by operators.

As leasable minerals are extracted, the deposits are depleted and would not be available for use in the future. Therefore, mineral extraction results in an irreversible commitment of the resource.

There are opportunities under all alternatives to access forest minerals and allow mining activities to provide materials for local communities, support local economies, and benefit the public generally. Extractive mineral activities that alter the landscape would most likely encumber other uses and ecological processes on NFS lands for the foreseeable future.

Environmental Consequences for Minerals and Mining – Alternatives 2, 3, 4, and 5

The action alternatives go further to include energy development activities. This is important because the potential exists for developing renewable energy (specifically, solar and wind power) on the Carson NF. And, the national forest recently received requests to look at possible wind power locations. The energy infrastructure from renewable energy development would have a potential impact to ecological conditions such as soil, water, and wildlife. For example, access roads or cleared sites would remove vegetation and increase habitat fragmentation. Developments would require a site location, access roads, and transmission lines. Plan language requires that these effects be evaluated and considered at the project level.

The action alternatives address reclamation activities for energy, mineral, and mining activities. While reclamation did occur under the old plan, these alternatives have plan direction for reclamation that would help to develop plans and addresses public safety and impacts to other resources. This plan language would lead to better-planned reclamation activities that contribute to desired conditions for other resources, such as protecting soil function and preventing increased stream siltation.

The action alternatives address the importance of recognizing recreational mining activities. Recreational mining is allowed by law, but putting language in the plan can improve opportunities for recreational miners and could encourage partnerships where recreational miners contribute to improved conditions for other forest resources, for example, volunteering to clean trash from mining sites or contributing to road maintenance.

Alternatives 2, 4, and 5 include recommended wilderness. Alternative 3 has no recommended wilderness. Infrastructure for energy development under special-use permit would not be permitted in recommended wilderness (MA-RWMA-S-5). Sale and extraction of common variety minerals would not be permitted in recommended wilderness (MA-RWMA-S-6). More recommended wilderness means there would be less area available for mineral extraction and would decrease the land available for potential wind, solar, or geothermal energy development. However, adequate opportunities for these activities exist elsewhere on

the Carson NF, and none of the recommended wilderness areas under any alternative have been identified as having high potential. Therefore, likely impacts from wilderness recommendation would be minimal, if any.

Alternatives 2, 4, and 5 include the Valle Vidal and San Antonio Management Areas. Both management areas exclude common mineral extraction and renewable energy development and associated infrastructure. Plan direction would not allow extraction of common minerals that may be important to local communities in the future for development. Currently, no common minerals are removed from these areas. Plan direction would also limit potential corridor routes. Currently, no energy infrastructure development is proposed or expected, but the plan direction would not allow future development. The plan direction would have a positive effect in terms of preventing soil disturbance, additional road construction, and negative impacts to natural scenery.

Cumulative Environmental Consequences for Minerals and Mining

Extensive oil and gas development occurs in the San Juan Basin, primarily in western Rio Arriba County and farther west in San Juan County. The Jicarilla Ranger District is in western Rio Arriba County. Farmington and surrounding communities are economically dependent on the oil and gas industry supported partially by the Carson, but also by BLM and other landowners in the Four Corners region. In New Mexico, oil and gas revenue is a major segment of the economy. Road density in the San Juan Basin region is higher than it would otherwise be to provide access to well sites, creating soil disturbance, altering runoff, and fragmenting habitat. Many small production equipment leaks are the likely cause of an abnormally high methane concentration in the Four Corners region (Kort et al. 2014).

The primary drivers for energy and minerals development are regional and national economic factors including supply and demand, technical factors, and political decisions. These factors determine whether commercial renewable energy development is economically viable, and whether oil and natural gas (fossil fuels) remain the primary fuels for energy generation.

In the long term, climate change may drive the energy market across the United States to use fewer fossil fuels (oil and natural gas) and increase the use of renewable energy (photovoltaic solar energy and wind) to generate electricity. However, in the near term, if temperatures continue to increase and precipitation decreases, additional energy may be needed for residential and commercial cooling and to pump more water for both agricultural and human use. If renewable energy generating and storage battery facilities cannot keep pace with the increased electrical demand, then additional fossil fuel (probably natural gas) resources will be necessary.

In Mora County, to the east of the national forest, the potential exists for gas development through fracking. Within the immediate range of the east and west zones on the Carson, there is no oil and gas development and the potential for development is limited. Currently, the price for oil and gas does not support the development of new wells. If the price of oil and gas reaches a level where opening new wells is profitable, there may be more interest and local economic benefit in the future.

The potential for increased renewable energy development exists in the area around the Carson. Wind, solar, and geothermal are all possibilities as communities look for cleaner and cheaper energy sources. The local electric company in northern New Mexico, Kit Carson Electric, is working toward generating all of its power from solar energy. Even if NFS lands are not developed directly, the potential exists for the installation of power transmission and distribution lines across the national forest. Installation of large-scale renewable energy sources could increase construction traffic along major highways through the forest as installations are built.

The national forest has several small mineral pits for gravel and sand for local community use, but the demand is not expected to grow. Demand for saleable minerals is likely to remain relatively stable. There

are adequate commercial and other sources and new saleable mining is not likely to be needed on NFS lands.

Vallecitos Federal Sustained Yield Unit

The Vallecitos Federal Sustained Yield Unit (unit) was established in 1948, under the authority of the Sustained Yield Forest Management Act of 1944. Its purpose is to “promote the stability of forest industries, of employment, of communities and of taxable forest wealth through continuous supplies of timber” (16 U.S.C. 583).

Description of Affected Environment

The Vallecitos Federal Sustained Yield Unit covers 73,400 acres on the El Rito Ranger District and contains mixed conifer and ponderosa pine forests, grasslands, and piñon-juniper woodlands. Since its inception, the unit has provided timber and other wood products intermittently, due to a variety of regulatory and provisional requirements that have proved difficult to fulfill and maintain. There are three distinct allowable annual cut volumes for two designated entities in the unit:

- The designated operator is allowed to harvest 5.5 MMBF of sawtimber.
- Local responsible operators are small, local businesses that have established primary manufacturing facilities within a set radius of the unit. They are allowed to harvest 1.0 MMBF of sawtimber and 1.1 MMBF of small forest products annually from the unit.

Currently, there is no operable sawmill near the unit to allow management to occur as designed. The Carson continues to perform thinning and fuel reduction projects within the unit to decrease fire risk and maintain the health of the forested ecosystems. Many of these projects have the additional purpose and benefit of making fuelwood accessible and available to the surrounding communities.

Environmental Consequences for the Vallecitos Federal Sustained Yield Unit

The unit has operated as intended infrequently in its 71 years, so it is unlikely to provide the timber and wood volumes via the mechanisms outlined in its designation. However, there remains demand for wood products, mainly fuelwood, from the adjacent communities that can be met through other means using the resources available on the unit. In the period between 2005 and 2015, 330 acres were commercially harvested, and 2,195 acres were non-commercially thinned. Both treatments produced fuelwood, as green fuelwood through block permits or as personal-use dead and down fuelwood.

The unit would continue to serve as a valuable source of forest products for local communities under all alternatives. The demand by local communities for fuelwood and other products would continue to drive treatments that would create commercial products or dead and down fuelwood opportunities. Under all alternatives, but specifically the action alternatives, the timber products in the unit would be available to support a sawtimber industry and provide lumber for community needs via the mechanisms outlined in the sustained yield unit designation. In the continued absence of an operable sawmill, it is likely that mainly fuelwood would be removed from the unit as a byproduct of restoration activities.

As with forest restoration treatments and commercial harvesting elsewhere, these activities in the unit could increase soil compaction, leading to reduced water infiltration rates, increased water runoff and soil erosion, and reduced soil productivity. Mechanical treatments may also necessitate the reopening or creation of new roads, leading to greater fragmentation of wildlife habitat and disruption of surface hydrology. Tree removal may also negatively impact the aesthetic quality of an area in the short term, leaving an unnatural appearance. Other effects of forest product removal would move resources toward desired conditions. The removal of some forest products would reduce competition for resources, ease drought stress, and increase the health and vigor of residual vegetation. Thinning of overstocked forests

can maintain forest structural stage distribution, lead to higher quality timber in the future, control insect and disease infestations, improve forage availability for wildlife, and reduce watershed risks from high-intensity fire.

Forest products contribute to local economies and livelihoods, creating opportunities to sustain existing industries or develop new industries based on the availability of supplies and needs of the people. Forest products also support traditional communities and culturally important activities and contribute to the long-term socioeconomic diversity and stability of local communities by providing a sustainable and continuous supply of products to meet demand. All alternatives have the potential for timber harvest from the unit to support local markets and contribute financially to area residents. All alternatives would provide opportunities for the public to collect dead and down fuelwood under permit.

The model of operations outlined by the sustained yield unit designation has not provided a reliable source of timber products or local employment and is not likely to do so in the future. Forest restoration in the unit is likely to occur at a slower pace than on other parts of the forest because of the difficulty in attracting commercial operators. Overstocked forests are likely to remain so, with resultant high fire risk, decreased resistance to pathogens, and altered hydrology.

Cumulative Environmental Consequences for the Vallecitos Federal Sustained Yield Unit

While rural and remote, the Vallecitos area is not as isolated as it was in 1948. Additional opportunities and services in nearby communities are more accessible now than in the past. People have moved away from the area. The demand for locally milled products and the local workforce to operate a mill are becoming less, not more, conducive to managing the sustained yield unit in the way that it was originally conceived. Competition from other area sawmills has increased because of easier distribution on better roads and highways, and large-scale restoration in the region has flooded the market with commercial timber and other products. The model that the sustained yield unit is designed around is probably less viable now than it has been in the past, and it will be unlikely to provide significant economic benefit to local communities.

Wilderness

The resource of wilderness is a quality of natural landscapes “where the earth and its community of life are untrammelled by man, where man himself is a visitor who does not remain” (Wilderness Act 1964, 16 U.S.C. 1131-1136). Wilderness as a resource is preserved and protected through congressional wilderness designation and is left unimpaired for future use and enjoyment as wilderness by management as a recommended wilderness.

In 1964, Congress acknowledged the immediate and lasting benefits of wild places by passing landmark legislation that permanently protected some of the most natural and undisturbed places in America. The Wilderness Act established the National Wilderness Preservation System “. . . to secure for the American people of present and future generations the benefits of an enduring resource of wilderness” (U.S. Congress 1964). Wilderness areas provide a wide variety of opportunities for exploration, solitude, natural risk, challenge, and primitive and unconfined recreation. Wilderness landscapes represent the Carson’s richest concentration of quiet places, where the sights and sounds of human activity are relatively unnoticeable. Developments (e.g., fences, structures, and water containment features) are rare; those that exist offer visitors a glimpse of past cultures and traditional land uses. Compatible uses in wilderness include grazing, camping, hiking, horseback riding, skiing, snowshoeing, and other forms of quiet recreation.

The Wilderness Act defines wilderness as undeveloped Federal land that has the following characteristics:

- It is affected primarily by the forces of nature, where people are visitors who do not remain;
- It provides outstanding opportunities for solitude or a primitive and unconfined type of recreation;
- It is of sufficient size as to make practicable its preservation and use in an unimpaired condition;
- It may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value.

Description of Affected Environment

Affected Environment for Designated Wilderness

Designated wilderness currently comprises about 7.5 percent of the Carson. The forest manages or co-manages six designated wilderness areas: Wheeler Peak (18,457 acres), Pecos (24,735 acres on the Carson), Latir (20,405 acres), Cruces Basin (18,867 acres), Chama River Canyon (2,949 acres on the Carson), and Columbine-Hondo (43,706 acres). The majority of the Pecos and Chama River Canyon wilderness areas are on the Santa Fe NF and both are jointly managed by the two forests.

Wilderness areas provide a wide variety of user opportunities for exploration, solitude, natural risk, challenge, and primitive and unconfined recreation. They also provide wildlife habitat and a variety of natural resource and social values. The Carson follows guidelines set forth in the Wilderness Act to maintain wilderness characteristics of the six wilderness areas it manages. With some exceptions, prohibitions in wilderness areas include closure to motorized and mechanized vehicles, timber harvest, new grazing and mining activity, or any other development. Livestock grazing is allowed in wilderness areas, unless specifically prohibited by the establishing legislation.

All of the Carson's wilderness areas have the following characteristics in common:

- The majority of use is day user versus overnight backpacking;
- The majority of camping occurs near water, not only for its desirability, but because the terrain is often flatter and more suited for camping;
- No permits are required to camp in or visit any of the Carson's wilderness areas;
- Every wilderness area has outfitters and guides with special use permits that offer services to the public for various wilderness area experiences and opportunities.

While the Carson is near the average among forests in regions 2 and 3 for total number of visitors (0.9 million versus median of 1.1 million), it is in the lower third for percentage of visits that are to wilderness areas (24 percent versus median of 36 percent) (USDA FS 2009b, 2013a).²⁰ Overall, wilderness visits between 2008 and 2013 averaged about 50,000 per year. Most wilderness areas on the Carson do not experience high use because they are difficult to access and have few developed trails. Nearly two-thirds (63.5 percent) of survey respondents said that Carson wilderness areas are uncrowded (a rating of 5 out of 10, or better) and only 2.7 percent said they were very crowded to overcrowded (a rating of 8 or higher) (USDA FS 2013a). The most common crowding rating was a 3 out of 10. Two exceptions are the portions of the Columbine-Hondo and Wheeler Peak Wilderness Areas that are accessible from New Mexico Highway 150, where most wilderness visits on the Carson are concentrated. These areas are easily accessible to visitors, have developed trailheads, and are popular with day hikers both from Taos County and from outside of the area. As a result, encounters among wilderness visitors are high in this corridor. Despite recent trends, increased wilderness visitation to all designated wilderness areas is expected in the future as the population of northern New Mexico continues to grow and visitation from outside the area continues to increase.

²⁰ <https://apps.fs.usda.gov/nvum/>

Areas Evaluated as Having Wilderness Characteristics

Wilderness areas are designated to protect and manage their wilderness character and preserve their natural conditions. As part of the plan revision process, the Carson assessed all areas within the forest not currently designated as wilderness for the degree to which they possess the wilderness characteristics listed above and the degree to which the area may be legally managed to preserve those wilderness characteristics. The Carson Wilderness Evaluation Report (USDA FS Carson NF 2019b) documents the assessment process and results. Thirteen areas were determined to possess wilderness characteristics (Areas Evaluated as Having Wilderness Characteristics) and each of those is included as a recommended wilderness management area (RWMA) in at least one alternative (table 72).

Table 72. Portion of areas evaluated as having wilderness characteristics that are considered as a recommended wilderness management area by alternative

Areas Evaluated as Having Wilderness Characteristics, Evaluation Number*: Acres	Alternative 1 Acres (RWMA Name)	Alternative 2 Acres (RWMA Name)	Alternative 3 Acres (RWMA Name)	Alternative 4 Acres (RWMA Name)	Alternative 5 Acres (RWMA Name)
Valle Vidal, Q4g: 9,361 acres	0	5,365 (Ash Mountain)	0	9,361 (McCrystal)	9,361 (McCrystal)
Midnight Meadow and Mallette Canyon, Q5n: 1,165 acres	0	1,165 (Esther Garcia)	0	0	1,165 (Esther Garcia)
Camino Real South, C14v: 12,597 acres	0	0	0	5,057 (Angostura)	12,597 (Jicarita Ridge)
Camino Real South, C14x: 2,340 acres	0	0	0	0	2,340 (Rio Chiquito)
Tres Piedras North, W17f: 1,675 acres	0	0	0	1,675 (Rudy)	1,675 (Rudy)
Tres Piedras North, W17k: 2,670 acres	0	1,038 (Toltec)	0	2,670 (Brazos Ridge)	2,670 (Brazos Ridge)
Tres Piedras North, W27a: 7,117 acres	0	0	0	7,117 (Olguin)	7,117 (Olguin)
Tres Piedras North, W29c: 2,491 acres	0	1,569 (Llano)	0	2,491 (Cisnero)	2,491 (Cisnero)
Tres Piedras North, W29e: 10,000 acres	0	0	0	10,000 (Oso)	10,000 (Oso)
Rio Chama, CrW5b: 82 acres	0	82 (Lobo)	0	82 (Lobo)	82 (Lobo)
Rio Chama, CrW6c: 21 acres	0	21 (Huckaby)	0	21 (Huckaby)	21 (Huckaby)
Ghost Ranch, W21d: 11,479 acres	0	0	0	0	11,479 (Comanche)
Sierrita de Canjilon, W32a: 6,998 acres	0	0	0	6,998 (Canjilon Meadows)	6,998 (Canjilon Meadows)
Total Acres	0	9,189	0	45,473	67,996

The evaluation number is a unique identifier for that specific area. The first letter refers to an area of the forest (Q=Questa Ranger District, C=Camino Real Ranger District, W=Westside, including the Tres Piedras, El Rito, and Canjilon Ranger Districts). The

number was assigned during the inventory phase of the wilderness process. The lower-case letter identifies portions of an inventory polygon and was assigned during the evaluation phase of the wilderness process. Some inventory polygons were subdivided multiple times (for reasons of wilderness characteristics, and then to meet the intent of an alternative). In those cases, a second number identifies each subdivision that is based on an alternative theme. The Ash Mountain and Toltec RWMAs were adjusted under alternative 2 to improve the definition of their boundary. Further subdivision that resulted from those adjustments in those two RWMAs is represented by a period followed by a third number.

Any area that is ultimately recommended for wilderness designation through the planning process is a preliminary administrative recommendation that may receive further review and modification by the Chief of the Forest Service, the Secretary of Agriculture, and the President of the United States prior to designation. The final authority to designate wilderness has exclusively been reserved by Congress. Recommended wilderness areas are managed to preserve the wilderness characteristics that form the basis for their recommendation. Recommendation for wilderness designation does not alter or restrict any valid existing rights.

Wilderness provides unique recreational opportunities by protecting the characteristics of solitude and primitive and unconfined experiences. Many people who do not currently visit wilderness areas still value their protection to maintain the opportunity to visit in the future (option value). Others gain benefit simply by knowing that natural areas exist (existence value) and that their protection today sustains them for future generations (bequest value). The option, existence, and bequest values together are known as passive use values (Loomis 2000). The demand for wilderness goes beyond recreation. Other values that may be associated with wilderness include long-term environmental monitoring, scenic vistas, protection of clean air and water, and maintenance of biological diversity.

Wilderness also limits certain activities and ecosystem services. No motorized or mechanized recreation is allowed, and no removal of forest products or mineral resources are permitted. Fire management, silvicultural practices, and restoration opportunities are all greatly restricted and more labor intensive where they can occur. Wilderness protection requires Carson resources in the form of personnel and money to sign and enforce wilderness restrictions and manage recreational impacts without modern materials or heavy equipment.

Affected Environment for Recommended Wilderness Management Areas

Ash Mountain (Q4g1.1, Q4g2.1, and Q4g2.2 – 5,314 acres)

Location: The Ash Mountain RWMAs are bounded by the forest boundary to the northeast and the rock wall geologic feature to the east. It ends at the top of the Leandro Creek drainage along a line that connects the narrowest point along the forest boundary to a surveyed point at 11,697 feet on the county line. The western boundary follows a straight line to the south-southwest to a point at approximately 11,480 feet, and just above closed forest road UD7_1167. It follows a straight line to the south-southeast to a minor, unnamed peak at approximately 12,060 feet along the Little Costilla Peak ridge. It follows the Little Costilla Peak ridge and county line to the south to a point ¼ mile north of the NFS Road 1950/1910 junction. The boundary parallels NFS Road 1950 along a straight line to a point ¼ mile north of the road on the Ash Mountain ridge. It follows the ridge for ¼ mile to a point at approximately 10,220 feet. Then it parallels Road 1950 again along a straight line to the east to a point along the rock wall, ½ mile from the road.

Description: The area includes Middle Ponil Creek and the Little Costilla Peak and Ash Mountain ridges to either side. It extends to the east to the rock wall geologic feature. Elevations range from 9,240 to 12,581 feet at the top of Little Costilla Peak. Vegetation is mostly spruce-fir forest, but there are some large open meadows, riparian areas, and alpine tundra. East of the Ash Mountain ridge there are some mixed conifer-frequent fire forests. The southern portion of the Middle Ponil Creek Canyon contains one of the largest bristlecone pine stands on the forest and in New Mexico.

Current Uses and Management: A user-created trail follows Middle Ponil Creek and is not heavily used; a trail from Elk Meadows to the top of Little Costilla Peak is more heavily used. Otherwise, the area is remote and undeveloped with little recreational or other use.

Ability to Preserve Wilderness Characteristics: There is no current motorized or mechanized use in this area, though mountain biking is not prohibited. There are many old, closed roads that come up to the eastern and western boundaries, but unauthorized motorized access is not currently an issue. The boundary to the west of Little Costilla Peak may be somewhat difficult to locate on the ground. While this would not likely cause an issue for enforcement, it would make identification and signage more difficult. Otherwise, boundaries generally follow prominent topographic features or the forest boundary.

Summary of the Evaluation: Plant and animal communities appear natural and appear to reflect ecological conditions that would normally be associated with the area in the absence of human intervention. Infrastructure in the area is rare and does not detract from apparent naturalness. There are high-quality opportunities to engage in primitive and unconfined recreation including hiking, horseback riding, viewing natural landscapes, and wildlife viewing. Human activities are uncommon, making opportunities to feel alone possible in much of the area. Other outstanding values include the bristlecone pine stand, Ash Mountain (shale rock peak), and the rock wall geologic feature.

Characteristics That Make the Area Suitable as Wilderness: Ecological characteristics—the majority of the area appears natural, it is mostly undeveloped with little infrastructure, and it contains unique features including scenery, geology, and vegetation communities. Social characteristics—there are opportunities for solitude throughout much of the area, there are opportunities for primitive and unconfined recreation, and access to most of the area is difficult due to steep and rugged terrain.

Esther Garcia (Q5n - 1,165 acres)

Location: The Esther Garcia RWMA is adjacent to the existing Latir Peak Wilderness and entirely within the Latir Peak Inventoried Roadless Area. The northern boundary follows the Carson National Forest boundary with adjacent Rio Costilla Cooperative Livestock Association (RCCLA) private lands. The southern boundary is offset by 300 feet from NFS Road 134. The eastern boundary follows a prominent unnamed ridge, part of which also defines the forest boundary.

Description: The area is very steep, rising from 9,600 to over 11,800 feet. The Rito Claro Canyon is the most prominent topographic feature. The dominant vegetation is spruce-fir forest with some aspen and grassy meadows in valley bottoms.

Current Uses and Management: The Midnight Trail is a lightly used hiking trail that winds back and forth between Carson and RCCLA land along the northern edge of this RWMA. The rest of the area is steep and inaccessible, with little recreational or other use. Road construction and timber production are restricted by the IRA designation.

Ability to Preserve Wilderness Characteristics: While snowmobiling is currently allowed, the area is difficult to access and little, if any, motorized or mechanized use currently occurs. The eastern boundary would be easier to manage than the Latir Peak Wilderness boundary because it follows a shorter, more prominent ridge.

Summary of the Evaluation: Plant and animal communities appear natural and appear to reflect ecological conditions that would normally be associated with the area in the absence of human intervention. Infrastructure in the area is rare or scattered and does not detract from apparent naturalness. Some high-quality opportunities to engage in primitive and unconfined recreation exist in the area including hiking, horseback riding, viewing natural landscapes, and wildlife viewing. Human activities are uncommon, making opportunities to feel alone possible in much of the area, especially away from NFS Road 134. No other outstanding values were identified.

Characteristics That Make the Area Suitable as Wilderness: Ecological characteristics—the majority of the area appears natural and the area is mostly undeveloped with little infrastructure. Social—the area offers opportunities for solitude and there are opportunities for primitive and unconfined recreation.

Llano (W29c1 – 1,569 acres)

Location: The Llano RWMA is defined by the forest boundary to the north and east, where it abuts BLM lands newly designated as the Rio San Antonio Wilderness. The eastern boundary follows the section lines for sections 23, 26, and 35. Its southern boundary is 1,000 feet from the T Bone Ranch private land. The southeastern corner parallels NFS Road 118 along a straight line that connects the corner of the forest boundary to the corner of the T Bone Ranch private land.

Description: The area includes the Rio San Antonio Canyon from north of the T Bone Ranch to the forest boundary, as well as some adjacent grasslands to the west. The topography slopes gradually from west to east, with a total relief of about 500 feet, mostly in the steep, narrow canyon itself. Vegetation is mostly grass meadows with some ponderosa pine along the western edge. There is an anomalous inclusion for this low elevation of mixed conifer and willow along the portion of the Rio San Antonio in this RWMA.

Current Uses and Management: The area is part of the San Antone grazing allotment, and the Laguna Larga area just to the west is developed with open roads, constructed water features, and fencing for livestock management, including cattle collection. Hunting occurs here in the fall for elk, deer, and pronghorn. The area is closed to snowmobiling but open to mountain biking, though there are no developed trails and no current use.

Ability to Preserve Wilderness Characteristics: There is likely some off-highway motorized use during the hunting season, but otherwise, motorized and mechanized use is not common. The forest boundary is fenced where this RWMA is adjacent to BLM wilderness, but the rest of the boundary is not identifiable on the ground and would have to be fenced and well-signed to prevent non-conforming uses. Still, enforcement would be problematic because there are no topographic features to separate developed, motorized uses from primitive wilderness uses. It would be very difficult to prevent impacts from human development and activity occurring outside the RWMA from affecting the solitude and unconfined values inside the RWMA.

Summary of the Evaluation: In general, plant and animal communities appear natural and appear to reflect ecological conditions that would normally be associated with the area in the absence of human intervention. Fence lines that concentrate wildlife and livestock impacts and movements are an exception. At certain times of year, evidence of trailing and different utilization levels may be apparent. Infrastructure other than fencing is rare inside the area and does not significantly detract from apparent naturalness. Opportunities exist to engage in primitive recreation including hiking, viewing natural landscapes, and wildlife viewing. Human activities are rare at some times during the year, providing opportunities to feel alone in parts of the area. Other outstanding values include the Rio San Antonio Canyon geology.

Characteristics That Make the Area Suitable as Wilderness: Ecological characteristics—the majority of the area appears natural, it is undeveloped with little infrastructure, and it contains unique canyon geology. Social characteristics—the area offers opportunities for solitude and primitive recreation.

Toltec (W17k3.1 – 1,038 acres)

Location: The Toltec RWMA is adjacent to and just west of the existing Cruces Basin Wilderness and is entirely within the Cruces Basin IRA. It is bounded to the north by Toltec Creek and an unnamed ridge in section 20 and to the south and east by the edge of Toltec Mesa.

Description: This area includes some small tributaries of the Rio de los Pinos. Elevations range from 9,200 to 10,500 feet. Vegetation is spruce and fir with open grassy meadows

Current Uses and Management: This area just to the south is popular for hunting, camping, and snowmobiling, particularly near NFS Road 74. North of Toltec Mesa, the topography is steep and less accessible and there is less human use.

Ability to Preserve Wilderness Characteristics: Winter snowmobiling and hunting season off-highway vehicle use are both very common along NFS Road 74 and in the surrounding area. Some of this may occur along the top of Toltec Mesa, but little occurs north of the mesa. Toltec Mesa is a prominent topographic feature that creates an identifiable boundary.

Summary of the Evaluation: Plant and animal communities appear natural and appear to reflect ecological conditions that would normally be associated with the area in the absence of human intervention. Infrastructure other than range fencing is rare and does not detract from apparent naturalness. There are opportunities to engage in primitive and unconfined recreation including: hiking, viewing natural landscapes, and wildlife viewing. Human activities are uncommon, making opportunities to feel alone possible in the area. No other outstanding values were identified.

Characteristics That Make the Area Suitable as Wilderness: Ecological characteristics—the majority of the area appears natural and it is mostly undeveloped with little infrastructure. Social characteristics—the area offers some opportunity for solitude and there are opportunities for primitive and unconfined recreation.

Lobo (CcW5b – 82 acres)

Location: The Lobo RWMA is surrounded by the Chama River Canyon Wilderness to the southeast and the BLM Rio Chama Wilderness Study Area to the north and west.

Description: The area is steep and rocky in Lobo Canyon where it meets Cebolla Canyon. It drops off quickly from 7,160 to 6,700 feet. Vegetation is sparse piñon and juniper, with herbaceous and willow riparian along Rio Cebolla.

Current Uses and Management: The area is part of the Cebolla grazing allotment and the unoccupied Mesa De Las Viejas Wild Horse Territory. The Hart Canyon Trail ends at the bottom of Cebolla Canyon about 2 miles from here. There are no trails in this RWMA.

Ability to Preserve Wilderness Characteristics: The Lobo RWMA is difficult to access, not heavily used, and surrounded by existing wilderness and BLM primitive areas. There is currently no motorized or mechanized use.

Summary of the Evaluation: In general, plant and animal communities appear natural and appear to reflect ecological conditions that would normally be associated with the area in the absence of human intervention. Infrastructure is rare inside the area and does not significantly detract from apparent naturalness. Opportunities exist to engage in primitive recreation including hiking, viewing natural landscapes, and wildlife viewing. Human activities are rare, providing opportunities to feel alone in the area. No other outstanding values have been identified.

Characteristics That Make the Area Suitable as Wilderness: Ecological characteristics—the majority of the area appears natural and it is undeveloped with little infrastructure. Social characteristics—the area offers opportunities for solitude and primitive recreation.

Huckaby (CrW6c - 21 acres)

Location: The Huckaby RWMA is surrounded by the Chama River Canyon Wilderness to the northwest and southwest. The eastern boundary is private land except for a 100-foot buffer that excludes private road 145N3 above the canyon rim.

Description: The area is steep and rocky with ponderosa pine forest. It drops off quickly from 7,880 feet to 7,600 feet at the bottom of Huckaby Canyon.

Current Uses and Management: The area is part of the Cebolla grazing allotment and the unoccupied Mesa De Las Viejas Wild Horse Territory, but it is below the canyon rim and not utilized. There are no trails in this RWMA, and it is generally inaccessible.

Ability to Preserve Wilderness Characteristics: The Huckaby RWMA is difficult to access due to the steep topography. There is currently no motorized or mechanized use. It is bordered by private land with a drivable road right up to the boundary, but the likelihood of non-conforming uses occurring below the canyon rim is low.

Summary of the Evaluation: In general, plant and animal communities appear natural and appear to reflect ecological conditions that would normally be associated with the area in the absence of human intervention. There is no infrastructure inside the area to detract from apparent naturalness. Opportunities exist to engage in primitive recreation including viewing natural landscapes and wildlife viewing. Human activities inside the RWMA are rare and the adjacent Chama River Canyon Wilderness provides opportunities to feel alone. No other outstanding values have been identified.

Characteristics That Make the Area Suitable as Wilderness: Ecological characteristics—the majority of the area appears natural and it is undeveloped without infrastructure. Social characteristics—the area offers opportunities for primitive recreation.

McCrystal (Q4g1 and Q4g2 – 9,361 acres)

Location: The McCrystal RWMA is bounded by the forest boundary to the north and NFS Road 1950 to the south. It ends at the top of the Leandro Creek drainage. The western boundary follows the Little Costilla Peak ridge until it nears Little Costilla Peak, where the boundary is irregular to the west of the ridge to exclude old roads but include the summit of Little Costilla Peak. The eastern boundary follows an old, closed, logging road and excludes stream developments, a windmill, and permitted roads.

Description: The area includes the Middle Ponil Creek and the Little Costilla Peak and Ash Mountain ridges to either side. It extends to the east to include the rock wall geologic feature and McCrystal Place historic site. Elevations range from 8,300 to 12,581 feet at the top of Little Costilla Peak. Vegetation is mostly spruce-fir forest west of the rock wall, with mixed conifer and ponderosa pine to the east. There are some large open meadows, riparian areas, and alpine tundra. The southern portion of the Middle Ponil Creek canyon contains one of the largest bristlecone pine stands on the forest and in New Mexico.

Current Uses and Management: An existing user-created trail follows Middle Ponil Creek and is not heavily used. A trail from Elk Meadows to the top of Little Costilla Peak is more well-used. The Middle Ponil drainage is remote and undeveloped with little recreational or other use. East of the rock wall geologic feature, there are some range improvements and old, closed, logging roads that hikers use.

Ability to Preserve Wilderness Characteristics: There is currently some limited motorized use in this area for prescribed burning implementation. Mountain biking is not prohibited, though little actually occurs. There is little other motorized or mechanized use occurring currently. There are many old, closed roads that come up to the eastern and western boundaries, but unauthorized motorized access is not generally an issue. The northwestern boundary is irregular and not entirely easily located on the ground. The eastern

boundary is a faded, closed road. While this would not likely cause an issue for enforcement, it would make identification and signage difficult.

Summary of the Evaluation: Plant and animal communities appear natural and appear to reflect ecological conditions that would normally be associated with the area in the absence of human intervention. Infrastructure in the area is rare and detracts from apparent naturalness only in very limited areas. There are high-quality opportunities to engage in primitive and unconfined recreation including hiking, horseback riding, viewing natural landscapes, and wildlife viewing. Human activities are uncommon making opportunities to feel alone possible in much of the area. Other outstanding values include the bristlecone pine stand, Ash Mountain (shale rock peak), the rock wall geologic feature, and McCrystal Place.

Characteristics That Make the Area Suitable as Wilderness: Ecological characteristics—the majority of the area appears natural, it is mostly undeveloped with little infrastructure, and it contains unique features including scenery, geology, and vegetation communities. Social characteristics—the area offers opportunities for solitude through much of the area, there are opportunities for primitive and unconfined recreation, and access is difficult due to steep and rugged terrain.

Angostura (C14v2 – 5,057 acres)

Location: A portion of the C14v AEW is outside of an inventoried roadless area but is not large enough to be managed as a standalone wilderness. The Angostura RWMA is adjacent to the existing Pecos Wilderness, which forms its southern border. It includes a portion of the Pecos IRA. It is bounded to the northeast by motorized trails 19A and 22A and to the southeast by an unnamed, prominent ridge above the Acequia Madre. The western boundary follows the Indian Canyon drainage, to include Ripley Point and portions of Trail 27, then follows Trail 36, offset by 300 feet to the west.

Description: The area includes the ridge from Ripley Point to Jicarita Peak and the steep canyons to its east. Elevations range from 9,050 to 12,510 feet. Vegetation is almost entirely spruce and fir forest, but there are about 430 acres of alpine tundra near Jicarita Peak.

Current Uses and Management: Trails 27 and 36 are very lightly used hiking trails with some rare mountain bike or illegal motorized use. They form part of the Jicarita Peak National Recreation Trail. Trail 27 is very steep and requires fording the Rio Santa Barbara. Other trails in the area, such as Trails 19 and 24, are much more popular and more scenic. Otherwise, the area is remote and undeveloped with little recreational or other use. Road construction and timber production are restricted by the IRA designation.

Ability to Preserve Wilderness Characteristics: There is very little current motorized or mechanized use in this area. The 22A/19A motorized trail surrounds the exterior of this area, but motorized use leaving the trail is not currently an issue due to the steep terrain and dense forest. Portions of the boundary in the northwest corner are not easily identifiable on the ground. While this would not likely cause an issue for enforcement, it would make identification and signage difficult.

Summary of the Evaluation: Plant and animal communities appear natural and appear to reflect ecological conditions that would normally be associated with the area in the absence of human intervention. Infrastructure in the area is rare and does not detract from apparent naturalness. There are opportunities to engage in primitive and unconfined recreation including: hiking, horseback riding, viewing natural landscapes, and wildlife viewing. Human activities are uncommon, making opportunities to feel alone possible in much of the area. Other outstanding values include the Jicarita Peak National Recreation Trail (though there are higher value, more popular trails in the area) and remnant structures and logging evidence from the 1907–1928 Santa Barbara Pole and Tie Company and Trampas Lumber Company.

Characteristics That Make the Area Suitable as Wilderness: Ecological characteristics—the majority of the area appears natural, it is mostly undeveloped with little infrastructure, and it contains unique features including scenery and high alpine vegetation communities. Social characteristics—the area offers opportunities for solitude through much of the area, there are opportunities for primitive and unconfined recreation, and access to most of the area is difficult due to steep and rugged terrain.

Cisnero (W29c1 and W29c2 – 2,491 acres)

Location: The Cisnero RWMA is defined by the forest boundary to the north and east, where it abuts BLM lands newly designated as the Rio San Antonio Wilderness. Its southern boundary is defined by the T Bone Ranch private land and extends west to within 1,000 feet of closed forest road 78D in section 33. The western boundary is to the east of Llano Tank, Cisneros Mine No. 1, and an unnamed pit tank near Laguna Larga.

Description: The area includes the Rio San Antonio Canyon from north of the T Bone Ranch to the forest boundary, as well as some adjacent grasslands to the west. The topography slopes gradually from west to east, with a total relief of about 600 feet, mostly in the steep, narrow canyon itself. Vegetation is mostly grass meadows with some ponderosa pine along the western edge. There is an anomalous inclusion for this low elevation of mixed conifer and willow along the portion of the Rio San Antonio in this RWMA.

Current Uses and Management: The area is part of the San Antone grazing allotment, and the Laguna Larga area just to the west is developed with open roads, constructed water features, and fencing for livestock management, including cattle collection. Hunting occurs here in the fall for elk, deer, and pronghorn antelope. The area is closed to snowmobiling but open to mountain biking, though there are no developed trails and no current use.

Ability to Preserve Wilderness Characteristics: There is likely some off-highway motorized use during the hunting season, but otherwise motorized and mechanized use is not common. The forest boundary is fenced where this RWMA is adjacent to BLM wilderness, but the rest of the boundary is not identifiable on the ground and would have to be fenced and well-signed to prevent non-conforming uses. Still, enforcement would be problematic because there are no topographic features to separate developed, motorized uses from primitive wilderness uses. It would be very difficult to prevent impacts from human development and activity occurring outside the RWMA from affecting the solitude and unconfined values inside the RWMA.

Summary of the Evaluation: In general, plant and animal communities appear natural and appear to reflect ecological conditions that would normally be associated with the area in the absence of human intervention. An exception are fence line impacts, which concentrate wildlife and livestock impacts and movements. At certain times of year evidence of trailing and different utilization levels may be apparent. Infrastructure other than fencing is rare inside the area and does not significantly detract from apparent naturalness. Opportunities exist to engage in primitive recreation including hiking, viewing natural landscapes, and wildlife viewing. Human activities are rare at some times during the year, providing opportunities to feel alone in parts of the area. Other outstanding values include the Rio San Antonio Canyon geology.

Characteristics That Make the Area Suitable as Wilderness: Ecological characteristics—the majority of the area appears natural, it is mostly undeveloped with little infrastructure, and it contains unique canyon geology. Social characteristics—the area offers opportunities for solitude and primitive recreation.

Oso (W29e - 10,000 acres)

Location: The Oso RWMA is bounded to the northeast by the forest boundary, and offset by 300 feet from Forest Road 78A along most of the eastern edge, except where it follows an unnamed minor ridge in order to exclude Chino Dry Lake (an altered stock tank). The southern boundary follows the Cañada de los

Ranchos drainage and existing fence lines. The western boundary is irregular, mostly following Lola Creek, but excluding several old, closed, but still evident roads.

Description: The most notable topographic feature is an unnamed prominent ridge that runs north-south through the middle of the RWMA and separates the Oso and Chino grazing pastures. Elevations range from 8,200 to 9,967 feet. The majority of the vegetation is Ponderosa Pine and dry Mixed Conifer forests, but there are also large grassy bluffs in the southern part of the area.

Current Uses and Management: The area is part of the San Antone grazing allotment and includes several stock tanks with access roads and some fencing. The Chino Dry Lake and Chino Tank area and the Oso Spring and Oso Tank area are just outside the RWMA boundary. They are both used frequently by range permittees during the summer for range management as campsites and livestock collection sites. They are developed with fencing, corrals, and parking sites. The RWMA is popular for hunting but currently closed to snowmobiling. There are no developed trails. There is little other recreational use. Motorized use is occasional and mostly permitted for range management purposes.

Ability to Preserve Wilderness Characteristics: There is infrequent motorized or mechanized use in this area. There are some old, closed roads within the RWMA that access dirt stock tanks. Unauthorized motorized access is not currently a frequent issue. Portions of the boundary do not follow topographic features and would not easily be located on the ground. This would make boundary identification and signage difficult, and may make enforcement difficult in some areas, such as around Chino Dry Lake, Indian Joe Tank, and Casas Tank.

Summary of the Evaluation: Plant and animal communities appear natural and appear to reflect ecological conditions that would normally be associated with the area in the absence of human intervention. Infrastructure in the area is rare and only detracts from apparent naturalness in confined, surrounding areas. There are opportunities to engage in primitive and unconfined recreation including: hiking, horseback riding, viewing natural landscapes, and wildlife viewing. Human activities are uncommon at some times of year, providing opportunities to feel alone. No other outstanding values have been identified.

Characteristics That Make the Area Suitable as Wilderness: Ecological characteristics—the majority of the area appears natural and it is mostly undeveloped. Social—the area offers opportunities for solitude and there are opportunities for primitive and unconfined recreation.

Rudy (W17f - 1,675 acres)

Location: The Rudy RWMA is adjacent to the existing Cruces Basin Wilderness and almost entirely within the Cruces Basin IRA. It is bounded by the wilderness boundary to the west and private land to the north. The southeastern boundary follows an unnamed ridge line and excludes NFS Road 87A and closed NFS Road 537 as far as Rudy Tank.

Description: The area slopes from the rim of the Cruces Basin down toward the northeast and the Rio de los Pinos. The high point is 10,022 feet at the wilderness boundary. The lowest elevations are about 8,500 feet near the river. It includes almost all of the watershed for the small Cañon Hondo drainage that empties into the Rio de los Pinos. Vegetation is spruce and fir forest.

Current Uses and Management: Road construction and timber production are restricted by the IRA designation. The RWMA is part of the San Antone range allotment and there are two dirt stock tanks. The area is open to snowmobiling and receives some use along the ridge overlooking the existing wilderness. Some hunting occurs here. Otherwise it is steep and undeveloped with little recreational or other use.

Ability to Preserve Wilderness Characteristics: The area is adjacent to an existing designated wilderness. For the most part, the remainder is steep and difficult to access. About one mile along Road 87A is flat

and leads to the rim of the Cruces Basin and is the only place where non-conforming uses would be a concern.

Summary of the Evaluation: Plant and animal communities appear natural and appear to reflect ecological conditions that would normally be associated with the area in the absence of human intervention. Infrastructure in the area is rare and does not detract from apparent naturalness. There are opportunities to engage in primitive and unconfined recreation including: hiking, horseback riding, viewing natural landscapes, and wildlife viewing. Human activities are uncommon during some times of year providing opportunities to feel alone. No other outstanding values were identified.

Characteristics That Make the Area Suitable as Wilderness: Ecological characteristics—the majority of the area appears natural and it is mostly undeveloped with little infrastructure. Social characteristics—the area offers opportunities for solitude during some times of year, there are opportunities for primitive and unconfined recreation, and access to most of the area is difficult due to steep and rugged terrain.

Brazos Ridge (W17k1, W17k2, and W17k3 - 2,670 acres)

Location: The Brazos Ridge RWMA includes all of the Toltec RWMA as well as additional areas totaling 1,632 acres. It is adjacent to and just west of the existing Cruces Basin Wilderness and is almost entirely within the Cruces Basin IRA. It is bounded to the north by Toltec Creek and the Carson boundary and to the south by the unnamed ridge that separates Osier and Cruces creeks. The western boundary is offset by 300 feet from NFS Road 74 and follows the Brazos Ridge including portions of the Continental Divide Trail.

Description: This area includes the headwaters of Osier Creek. Elevations range from 9,200 to 10,800 feet. Vegetation is spruce and fir with open grassy meadows

Current Uses and Management: This area is popular for hunting, camping, and snowmobiling, particularly near Road 74. The Continental Divide Trail is popular for hiking and currently has some mountain bike use.

Ability to Preserve Wilderness Characteristics: Winter snowmobiling and hunting season off-highway vehicle use are both very common along Road 74 and in the surrounding area. The best topographic barrier is the ridgeline that defines the Cruces Basin and the current designated wilderness boundary. This RWMA is on the opposite slope from the current wilderness and it would make preventing non-conforming uses from entering the wilderness somewhat more difficult.

Mountain bike traffic on the Continental Divide Trail would have to be rerouted onto Road 87 and would bypass the views from the trail into the Cruces Basin Wilderness. There would likely be some non-compliance and it would be difficult to enforce.

Summary of the Evaluation: Plant and animal communities appear natural and appear to reflect ecological conditions that would normally be associated with the area in the absence of human intervention. Infrastructure other than range fencing is rare and does not detract from apparent naturalness. There are opportunities to engage in primitive and unconfined recreation including: hiking, viewing natural landscapes, and wildlife viewing. Human activities are uncommon at some times of year, making opportunities to feel alone possible in the area. Other outstanding values include the Continental Divide Trail.

Characteristics That Make the Area Suitable as Wilderness: Ecological characteristics—the majority of the area appears natural and it is mostly undeveloped with little infrastructure. Social characteristics—the area offers some opportunity for solitude and there are opportunities for primitive and unconfined recreation.

Olguin (W27a - 7,117 acres)

Location: The Olguin RWMA is bounded by the forest boundary to the west and Tanques Canyon to the south. The eastern edge follows the rim of Olguin Mesa and excludes the Olguin Mesa Tank and its access road, closed NFS Road 663A1. The northern boundary is irregularly shaped but mostly follows Cañon Puela and Lagunitas Creek Canyon and excludes multiple dirt stock tanks, range fences, and restoration work that is occurring in Rio San Antonio.

Description: The area includes the headwaters of Rio San Antonio and most of Lagunitas Creek. It includes all of the top of Olguin Mesa. Elevations range from 9,240 to 10,450 feet. Vegetation is a mix of Spruce-Fir Forest and dry alpine grasslands with large wet meadow riparian areas in the drainage bottoms.

Current Uses and Management: This area is part of the Lagunitas grazing allotment and there are several fences that cross it. The Continental Divide Trail runs from north to south through the length of this RWMA. The Rio San Antonio is popular for fishing farther downstream, but less so in this area. The area is open to snowmobiling and does receive some use, mostly near the northern end. This area is also very popular for hunting.

Ability to Preserve Wilderness Characteristics: There is currently snowmobile and mountain bike use in this area, particularly along the forest boundary and Continental Divide Trail in the Lagunitas Campground area. There are some old, closed roads that enter the area from the north that are used by grazing permittees for range management, but unauthorized motorized access is not currently an issue. Portions of the boundary are not easily located on the ground. While this would not likely cause an issue for enforcement, it would make identification and signage difficult.

Summary of the Evaluation: Plant and animal communities appear natural and appear to reflect ecological conditions that would normally be associated with the area in the absence of human intervention. Infrastructure in the area is rare and does not detract from apparent naturalness. There are high quality opportunities to engage in primitive and unconfined recreation including: hiking, horseback riding, viewing natural landscapes, and wildlife viewing. Human activities are uncommon during some times of year providing opportunities to feel alone. Other outstanding values include the Continental Divide Trail.

Characteristics That Make the Area Suitable as Wilderness: Ecological characteristics—the majority of the area appears natural, it is mostly undeveloped with little infrastructure, and it contains unique features including scenery, geology, and vegetation communities. Social characteristics—the area offers opportunities for solitude during some times of year and there are opportunities for primitive and unconfined recreation.

Canjilon Meadows (W32a - 6,998 acres)

Location: The Canjilon Meadows RWMA includes portions of the Canjilon Mountain IRA. It is bounded to the north by the forest boundary, to the east by NFS Road 274 and the district boundary, and to the south by the Arriba grazing pasture fence line. The western boundary is irregularly shaped but includes the Canjilon Mountain ridge and Canjilon Meadows and excludes several dirt stock tanks and their access roads, as well as other old, closed roads.

Description: The area includes the headwaters of Canjilon Creek and Rio Nutrias, the north side of Canjilon Mountain, and the ridge to the north. Elevations range from 9,300 feet near Trout Lakes to 10,913 feet at the top of Canjilon Mountain. Vegetation is a mix of Spruce-Fir Forest and dry alpine grasslands with large wet meadow riparian areas in the drainage bottoms.

Current Uses and Management: There is heavy visitation in this area throughout the year, particularly near the Canjilon Lakes and Trout Lakes campgrounds. The RWMA includes portions of the Jarosa,

Nutrias, Salvador Complex, and Cebolla grazing allotments and there are many allotment and pasture fences that cross it. The Continental Divide Trail runs from north to south through the east side of the area. Trail 54 makes a loop along the Canjilon Mountain ridge. The area is open to snowmobiling and does receive some use. It is also very popular for hunting. There are some old, closed roads that receive significant illegal motorized use, particularly during hunting season.

Ability to Preserve Wilderness Characteristics: There is currently snowmobile and some illegal off-highway vehicle use. There are old closed roads on the eastern side that are used by grazing permittees for range management. Portions of the boundary are not easily located on the ground. This would complicate enforcement because it would make identification and signage difficult. There is significant, strong opposition to recommendation in the local communities and non-compliance would likely be an issue.

Summary of the Evaluation: Plant and animal communities appear natural and appear to reflect ecological conditions that would normally be associated with the area in the absence of human intervention. Infrastructure in the area, other than range fencing, is rare and does not detract from apparent naturalness. There are opportunities to engage in primitive and unconfined recreation including: hiking, horseback riding, viewing natural landscapes, and wildlife viewing. Outstanding values include the Continental Divide Trail and Canjilon Mountain.

Characteristics That Make the Area Suitable as Wilderness: Ecological characteristics—the majority of the area appears natural and it is mostly undeveloped with little infrastructure other than fences. Social characteristic—there are opportunities for primitive and unconfined recreation.

Jicarita Ridge (C14v1, C14v2, and C14v3 – 12,597 acres)

Location: The Jicarita Ridge RWMA includes the Angostura RWMA included in alternative 4 plus two additional areas that are almost entirely within the Pecos IRA. It is adjacent to the existing Pecos Wilderness, which forms its southern border. The northwest boundary follows the existing IRA boundary along an unnamed ridge west of Rio Santa Barbara and an unnamed ridge to Bear Mountain, excluding the Santa Barbara Campground recreation site. Trail 28 is excluded, Ripley Point is included, and then motorized trails 19A and 22A are excluded. The Acequia Madre is excluded along prominent ridges. The southeast corner excludes old, closed roads and there are about 1.5 miles that abut the Santa Fe NF.

Description: The area includes the Alpine Tundra above tree line on the ridge from Ripley Point to Jicarita Peak and the steep canyons to either side. It includes a portion of the Rio Santa Barbara and the headwaters of Indian, Jicarita, Agua Piedra, and Alamitos creeks. Elevations range from 8,640 to 12,510 feet. Vegetation is almost entirely Spruce and Fir forest, but there are about 430 acres of alpine tundra near Jicarita Peak and some mixed conifer at lower elevations around Santa Barbara Campground.

Current Uses and Management: Trail 24 and the Santa Barbara Campground are very popular for hiking and horseback riding. They are the most common Pecos Wilderness entry point from the Carson National Forest side. Trail 19 is also popular and leads to Serpent Lake in the wilderness. Trails 27 and 36 are very lightly used hiking trails with some rare mountain bike or illegal motorized use. Along with Trail 19 they form part of the Jicarita Peak National Recreation Trail. Trail 27 is very steep and requires fording the Rio Santa Barbara. Forest Road 116 to the campground is very busy during the summer and fall. The area around Bear Mountain is heavily used and there is frequent illegal motorized use off of Trails 20 and 22, just outside this RWMA and possibly encroaching into it. Other parts of the area are remote and undeveloped with little recreational or other use. Road construction and timber production are restricted in most of the area by the IRA designation.

Ability to Preserve Wilderness Characteristics: This RWMA includes portions of the Santa Barbara, Knob, and Angostura grazing allotments. There is some fencing that needs to be maintained, but for the most part pasture and allotment boundaries are defined by the steep topography. There is very little

current motorized or mechanized use in this area. The 22A/19A motorized trail surrounds the exterior of this area to the northeast, but motorized use leaving the trail is not currently an issue due to the steep terrain and dense forest. There is motorized use around Bear Mountain, outside the RWMA, which may spill over into this RWMA. The extent of that non-compatible use is small. Portions of the boundary around Bear Mountain and in the southeast corner are not easily identifiable on the ground. This would make enforcement, identification, and signage difficult. There is significant, strong opposition to recommendation in the local communities and non-compliance would likely be an issue.

Summary of the Evaluation: Plant and animal communities appear natural and appear to reflect ecological conditions that would normally be associated with the area in the absence of human intervention. Infrastructure in the area is rare and does not detract from apparent naturalness. There are opportunities to engage in primitive and unconfined recreation including: hiking, horseback riding, viewing natural landscapes, and wildlife viewing. With the exception of the NFS Road 136 corridor and the Santa Barbara Campground area, human activities are uncommon, making opportunities to feel alone possible in much of the area. Other outstanding values include the Jicarita Peak National Recreation Trail and remnant structures and logging evidence from the 1907–1928 Santa Barbara Pole and Tie Company and Trampas Lumber Company.

Characteristics That Make the Area Suitable as Wilderness: Ecological characteristics—the majority of the area appears natural, it is mostly undeveloped with little infrastructure, and it contains unique features including scenery and high alpine vegetation communities. Social characteristics—there are opportunities for solitude throughout much of the area, there are opportunities for primitive and unconfined recreation, and access to most of the area is difficult due to steep and rugged terrain.

Rio Chiquito (C14x – 2,340 acres)

Location: The Rio Chiquito RWMA is adjacent to the existing Pecos Wilderness along its southern and eastern borders. It includes most of the Pecos IRA, and generally follows the existing IRA boundary but excludes some old, closed roads to the south of Rio San Leonardo.

Description: The area includes the west side of the Trampas Peak ridge, which is also the Pecos Wilderness boundary. It includes the north slope of Trampas Peak, which forms the headwaters of Rio Chiquito. It also includes part of the Rio de las Trampas and Rio San Leonardo. Elevations range from 9,000 to 12,170 feet on Trampas Peak. Vegetation is almost entirely spruce and fir and wet mixed conifer forests.

Current Uses and Management: This RWMA includes portions of the Trampas and Rio Chiquito grazing allotments. There is little range infrastructure at these elevations and the allotment boundary is mainly topographic features. Trails 30 and 31 are both popular for hiking and horseback riding. The rest of the area is steep and inaccessible, with little recreational or other use.

Ability to Preserve Wilderness Characteristics: There is very little current motorized or mechanized use in this area. The Trampas trailhead can be busy at times during the summer and fall. There are old, closed roads that come up to the northern edge of this RWMA. Portions of the western and northern boundaries are not easily identifiable on the ground. While this would not likely cause an issue for enforcement, it would make identification and signage difficult. However, there is significant, strong opposition to recommendation in the local communities and non-compliance may be an issue.

Summary of the Evaluation: Plant and animal communities appear natural and appear to reflect ecological conditions that would normally be associated with the area in the absence of human intervention. Infrastructure in the area is rare and does not detract from apparent naturalness. There are opportunities to engage in primitive and unconfined recreation including: hiking, horseback riding, viewing natural

landscapes, and wildlife viewing. Human activities are uncommon making opportunities to feel alone possible in much of the area. No other outstanding values were identified.

Characteristics That Make the Area Suitable as Wilderness: Ecological characteristics—the majority of the area appears natural and it is mostly undeveloped with little infrastructure. Social characteristics—there are opportunities for solitude throughout much of the area, there are opportunities for primitive and unconfined recreation, and access to most of the area is difficult due to steep and rugged terrain.

Comanche (W21d – 11,479 acres)

Location: The Comanche RWMA includes most of the Bull Canyon IRA and for the most part follows the same boundary. There are three exceptions. In the southeast, the RWMA is larger than the IRA where it follows Arroyo del Chamiso and closed Forest Road 23. To the west it is slightly larger where the RWMA follows topographic features rather than section lines. On its southwestern side the RWMA is smaller than the IRA where the IRA surrounds Ghost Ranch private land and extends as far as US Highway 64, while the RWMA ends on top of the prominent cliffs that form the canyon rim.

Description: The area includes the broad valley of Bull Canyon and Comanche Canyon drainages below striking geologic formations of red and tan sandstone made famous by artist Georgia O’Keeffe. Elevations range from 6,400 to 8,700 feet. Vegetation is almost entirely piñon and juniper, but there are about 550 acres of ponderosa pine at the highest elevations.

Current Uses and Management: The portion of this RWMA on the El Rito Ranger District is part of the El Rito-Lobato grazing allotment. There is little range infrastructure in the RWMA, but there are current discussions with grazing permittees to add stock tanks in Comanche Canyon. Most of the area is also part of the unoccupied Mesa Montosa Wild Horse Territory.

A system of trails behind the Ghost Ranch private land has moderate use. Only one of these, Trail 50, is a Carson system trail. Otherwise, the area is remote and undeveloped with little recreational or other use. Road construction and timber production are restricted by the IRA designation.

Ability to Preserve Wilderness Characteristics: Due to the very steep, dissected terrain there is very little current motorized or mechanized use in this area. Vehicles are prevented from entering the RWMA from the top by steep cliffs. This is also true from the bottom in the Ghost Ranch area. The Comanche Canyon area is more accessible to non-conforming uses, but illegal motorized use is not currently an issue.

Summary of the Evaluation: Plant and animal communities appear natural and appear to reflect ecological conditions that would normally be associated with the area in the absence of human intervention. Infrastructure in the area is rare and does not detract from apparent naturalness. There are high-quality opportunities to engage in primitive and unconfined recreation including: hiking, horseback riding, viewing natural landscapes, and wildlife viewing. Human activities are uncommon making opportunities to feel alone possible in much of the area. Other outstanding values include sandstone cliffs, fossils, and rare plants, including Chacon milkvetch, Chama blazing star, and tufted sand verbena.

Characteristics That Make the Area Suitable as Wilderness: Ecological characteristics—the majority of the area appears natural, it is mostly undeveloped with little infrastructure, and it contains unique features including scenery, fossil beds, and rare vegetation communities. Social characteristics—there are opportunities for solitude throughout much of the area, there are opportunities for primitive and unconfined recreation, and access to most of the area is difficult due to steep and rugged terrain.

Environmental Consequences for Wilderness

Methodology and Analysis Process

The effects of existing designated wilderness areas, including their existing condition were analyzed in combination with varying levels of recommended wilderness by alternative. The majority of the analysis is directed toward the programmatic environmental consequences of the RWMAs under each alternative, and the environmental consequences of each RWMA individually.

Analysis Assumptions

- All designated wilderness is managed according to the Wilderness Act, 36 CFR 293, applicable Forest Service manuals and handbooks, individual wilderness area management plans, and the Carson Land Management Plan.
- The Forest Service developed wilderness stewardship performance measures in 2016 to more effectively measure how well the Forest Service is meeting its primary responsibility under the Wilderness Act – to preserve wilderness character. There are seven categories of wilderness stewardship performance elements that forests may choose from for each wilderness: natural quality of wilderness character; undeveloped quality of wilderness character; untrammeled quality of wilderness character; outstanding opportunities for solitude or primitive and unconfirmed recreation quality of wilderness character; other features of value; quality of wilderness character; special provisions; and administration. Recommended wilderness areas are not measured against the wilderness stewardship performance elements.
- Wilderness stewardship performance scores are expected to rise steadily over the next decade as the Carson manages wilderness character based on this new performance measure and a new plan.
- Livestock management in designated wilderness conforms to the Congressional Grazing Guidelines (FSM 2320 – Wilderness Management 2323.22-Exhibit 01, Congressional Grazing Guidelines).

Indicators

- Acres of designated and recommended wilderness
- Protection of wilderness character
- Protection of wilderness characteristics outside of recommended wilderness
- Watershed and wildlife habitat condition
- Recreational opportunities (both wilderness compatible, and motorized/mechanized or semi-primitive)
- Vegetation and fuels condition and related impacts to adjacent lands and values (e.g., increased fire risk)

Environmental Consequences for Wilderness Common to All Alternatives

Under all alternatives, there would be no change to current designated wilderness. Designated wilderness would continue to be managed using applicable law, regulation, and policy to preserve wilderness character. A primitive experience would be maintained for all six wilderness areas. Natural ecological processes and disturbance would be the primary forces affecting the composition, structure, and patterns of vegetation. Wilderness areas would continue to be managed to protect and maintain their wilderness characteristics. Regulations for group size are the same across all alternatives (maximum group size for camping/hiking/riding at 15 people and a maximum number of pack and saddle stock allowed in a group is 15 head) in order to preserve opportunities for solitude.

Environmental Consequences for Wilderness Common to Alternatives 1 and 3

Alternatives 1 and 3 have no RWMA. Opportunities for solitude and primitive recreation would be rarer under these alternatives because development or motorized and mechanized uses would be allowed in more areas of the forest. Recreational pressure and crowding would be rare, but slightly more likely compared to other alternatives since fewer wilderness opportunities would be available resulting in fewer opportunities for solitude. Wilderness use would be most concentrated under these alternatives, which may lower the ability to protect wilderness character and values such as solitude and apparent naturalness. However, dispersal in most existing wilderness areas is currently high so that any additional dispersal under other alternatives would likely be negligible and overall differences in opportunities for solitude across the forest would be similar to those under alternative 2.

Alternatives 1 and 3 would provide more opportunities for future development of recreation facilities. More facilities development would be allowed under these alternatives. Those desiring semi-primitive type recreation, access to rustic or more developed facilities, or the ability to hold competitive events would have more options, and crowding in semi-primitive, non-motorized areas would be slightly reduced.

Areas evaluated as having wilderness characteristics but not managed as RWMA could potentially become more developed, with local impacts to soils, watershed condition, or wildlife habitat. However, any impacts would be mitigated according to the plan components for those specific resources and would be minimal. Opportunities for restoration would be greatest since no additional limitations would be imposed on the methods or tools that could be used.

Environmental Consequences for Wilderness - Alternative 2

A total of 9,189 acres of recommended wilderness in six RWMA are included in this alternative. The RWMA included in this alternative are areas where wilderness protection: (1) would not impact management activities for restoration of fire dependent ecosystems (ponderosa pine forests and dry mixed conifer) and water resources; and (2) would not limit important ecosystem services that local communities rely on. They are: Ash Mountain (Q4g1.1, Q4g2.1, Q4g2.2), Esther Garcia (Q5n), Llano (W29c1), Toltec (W17k3.1), Lobo (CrW5b), and Huckaby (CrW6c).

Recommended wilderness would benefit some wildlife species because primitive management would minimize disturbance and provide habitat connectivity. Conversely, limited ability to mechanically treat in these areas may mean that ecological conditions become more departed which may negatively impact wildlife. For example, any wetland restoration would be accomplished by hand instead of using heavy machinery and would take longer meaning less would be accomplished (USDA FS Carson NF 2018a). Mechanical thinning of overstocked forests could be done by hand, with crosscut saws and then treating the slash to maintain scenic integrity. These restrictions would increase the cost and difficulty of treatments, would reduce the restoration return on investment, and would therefore make projects less attractive, and less likely to get accomplished by the Carson NF or partners (USDA FS Carson NF 2018a). While for the most part the current management in these six RWMA would not change significantly were they to be managed as recommended wilderness, future management options could be limited by restrictions on motorized and mechanized uses or those restrictions could provide additional protections from future human uses and activities that may occur.

Some recommended areas would assist in wilderness management where they are adjacent to existing designated wilderness, but the recommended wilderness boundary would follow more prominent topographic features than the current boundary (Esther Garcia, Lobo, and Huckaby RWMA). Wilderness characteristics would be better protected because uses would be better segregated by topography.

The Toltec RWMA may make boundary management more difficult because it extends the existing Cruces Basin Wilderness boundary along the relatively flat Toltec Mesa toward open NFS Road 74. Wilderness characteristics may be difficult to protect because motorized and mechanized uses along the road would be more likely to encroach on and impact the apparent naturalness and primitive experience in this area, compared to the existing wilderness.

The effects of recommending the Esther Garcia (Q5n - 1,165 acres), Lobo (CcW5b – 82 acres), and Huckaby (CrW6c - 21 acres) RWMAs would be similar to those under alternative 1. Due to the steep and rugged terrain, there is little likelihood of development or motorized or mechanized management or other uses in this area regardless of whether they are explicitly prohibited.

The Ash Mountain (Q4g1.1, Q4g2.1, Q4g2.2 – 5,314 acres) RWMA includes some frequent fire systems that would be more prone to uncharacteristic, high-severity wildfire because mechanical fuels treatments would be less likely to occur. These areas may experience uncharacteristic tree mortality or effects to soils were a fire to occur. However, additional risk from wildfire to adjacent infrastructure, cultural resources, or other values at risk would be minimal since fuels in adjacent areas could still be mechanically treated.

With recommendation of Llano (W29c1 – 1,165 acres) RWMA, the motorized-based hunting that currently occurs in this area would be limited resulting in some marginal benefit to soil condition. However, any motorized game retrieval that would be prevented is infrequent and not widespread, and any benefit would be minimal. There would be no change to grazing management other than maintenance would be done without machinery where feasible, which would be more costly and time consuming. The range infrastructure in this RWMA is a small portion of the total range infrastructure on the allotment and the impact would be small.

The addition of Toltec (W17k3.1 – 1,038 acres) RWMA would effectively extend the Cruces Basin Wilderness north along the Rio de los Pinos. It would limit snowmobile access to a viewpoint into the Cruces Basin at the top of Toltec Mesa and would remove a small amount of popular snowmobiling terrain. Removing motorized use from the Toltec area would benefit some wildlife that is sensitive to noise from snowmobiles, such as big game. It would provide additional connected habitat and reduce impacts to those species. Vegetation management would change very little from what it is currently, and effects would be similar. However, spruce trees just to the north have been severely impacted by beetle infestation and an RWMA would limit any mechanical timber management were that outbreak to expand here. Widespread removal of affected trees to limit infestation spread would likely not be compatible with preserving wilderness characteristics. Not removing affected trees could allow the infestation to spread throughout or beyond the RWMA, leading to widespread tree mortality, loss of canopy cover, and loss of habitat.

Environmental Consequences for Wilderness – Alternative 4

A total of 45,473 acres of recommended wilderness in 10 RWMAs are included in this alternative. The RWMAs included in this alternative are areas where recommended wilderness management area plan components would limit commercial timber harvest and/or motorized use that might otherwise occur. They include those areas with wilderness characteristics that are not part of an inventoried roadless area where timber harvest is not therefore already prohibited. Or they are part of an inventoried roadless area where motorized use currently occurs. They are: McCrystal (Q4g1 and Q4g2), Angostura (C14v2), Cisnero (W29c1 and W29c2), Oso (W29e), Rudy (W17f), Brazos Ridge (W17k1, W17k2, and W17k3), Olguin (W27a), Canjilon Meadows (W32a), Lobo (CrW5b), and Huckaby (CrW6c).

Some recommended areas would assist in wilderness management where they are adjacent to existing designated wilderness, but the recommended wilderness boundary would follow more prominent topographic features than the current boundary (Lobo and Huckaby RWMAs). Wilderness characteristics would be better protected because uses would be better segregated by topography.

The Brazos Ridge and Rudy RWMAs would make boundary management more difficult because they extend the existing Cruces Basin Wilderness boundary beyond the most prominent topographic feature. Wilderness characteristics would be difficult to protect because motorized and mechanized uses would not be separated by topography.

Some areas include frequent fire systems that would be more prone to uncharacteristic, high-severity wildfire because mechanical fuels treatments would be less likely to occur. These areas may experience uncharacteristic tree mortality or effects to soils were a fire to occur. Adjacent infrastructure, cultural resources, and other values at risk may be at higher risk from wildfire because aggressive fuels treatments, such as fuel breaks, that would not appear natural would not be allowed in these areas.

Recommended wilderness would benefit some wildlife species because primitive management would minimize disturbance and provide habitat connectivity. Habitat for some wildlife would be improved because it would not be impacted by vehicle noise in recommended areas. This effect is compounded in the Cruces Basin area because there are multiple recommended areas where snowmobiling would not be allowed. Alone, this would concentrate over-snow motorized use into nearby areas, but alternative 4 also limits this use everywhere in the San Antonio Management Area, which would likely cause crowding and a worse recreational experience in those areas where over-snow motorized use would be allowed. Conversely, limited ability to mechanically treat in these areas may mean that ecological conditions become more departed, which could negatively impact wildlife habitat.

Effects of recommending Lobo (CcW5b – 82 acres), and Huckaby (CrW6c - 21 acres) RWMAs would be the same as alternative 2.

For the Llano portion of the Cisnero RWMA, the effects of recommending Cisnero (W29c1 and W29c2 – 2,491 acres) RWMA would be the same as under alternative 2. The remainder of this RWMA contains more ponderosa pine forests that would be less likely to be mechanically treated under this alternative. These areas may experience uncharacteristic tree mortality or effects to soils were a fire to occur. However, additional risk from wildfire to adjacent infrastructure, cultural resources, and or other values at risk would be minimal since fuels in adjacent areas could still be mechanically treated. The boundary would be closer to open NFS Road 78 and not easily identifiable on the ground. Motorized intrusion would be more likely than under alternative 2.

For the Ash Mountain portion of the McCrystal RWMA, the effects of recommending McCrystal (Q4g1 and Q4g2 - 9,361 acres) RWMA would be the same as alternative 2 and similar to those under alternatives 1 and 3. The remaining portion that is east of the rock wall geologic feature and contains frequent fire forest vegetation communities would be less likely to be treated mechanically or with planned prescribed fire and would likely remain overstocked and departed from desired conditions. High-intensity, stand-replacing fire would be more likely with resulting loss of canopy, long-term conversion to non-forest vegetation (shrubs, grass), increased sedimentation and soil erosion, and loss of soil function. Less aggressive fuels and fire management would increase the risk of damage to nearby infrastructure including Cimarron Campground, Shuree Lodge and Campground, and the McCrystal Place historic site, because treatments such as fuel breaks that would not appear natural would not be allowed. In addition, fire management at the forest boundary with private land to the north would be more difficult because fuels would be left natural instead of managed to assist fire suppression and more labor intensive suppression tactics would be used when possible.

Effects of recommending Angostura (C14v2 – 5,057 acres) RWMA would be similar to those under alternative 1. Due to steep and rugged terrain and the IRA designation of a portion of the area, there is little likelihood of development, motorized or mechanized management, or other uses in this area regardless of whether they are explicitly prohibited. The occasional illegal motorized use that occurs on Trail 36 would not necessarily be better-controlled by wilderness recommendation, since there is not an

obvious topographic barrier to prevent it. While mountain biking is currently allowed throughout the area, almost none actually occurs, and the impact of recommendation would be negligible.

With recommendation of Oso (W29e - 10,000 acres) RWMA, the motorized-based hunting that currently occurs in this area would be limited, resulting in some marginal benefit to soil condition. However, any game retrieval that would be prevented is infrequent, not widespread, and any benefit would be minimal. There would be some change to grazing management because maintenance would need to be done without machinery where feasible, which would be more costly and time consuming. There are several dirt tanks that provide water for and disperse livestock and wildlife that would no longer be maintained. Livestock and wildlife would be less likely to use this area, and other nearby areas would experience greater grazing pressure and higher forage utilization.

The ponderosa pine and dry mixed conifer forests in the Oso RWMA would be less likely to be treated mechanically or with planned prescribed fire and would likely remain overstocked and departed from desired conditions. High-intensity, stand-replacing fire would be more likely because fuels would be less likely to be treated. There are almost 7,000 acres of these vegetation communities, which is a small percentage of the total on the forest but could have significant impacts on this landscape. These Frequent Fire Forest types continue beyond the Oso RWMA to the west, and any fire that started there would easily spread into the RWMA. Frequent-fire types also continue to the north onto the Los Pinos State Recreation Area. Because more aggressive fuels treatments such as fuel breaks that would not appear natural would not be used these popular camping and fishing sites and park infrastructure would be at greater risk from uncharacteristically high-severity fire spreading from the RWMA, affecting recreation opportunities. The Rio de los Pinos is a large river for the area and provides high-quality fishing. Most of the Oso RWMA drains into Lola Creek, a Rio de los Pinos tributary, or into Rio de los Pinos directly. High-intensity fire in this watershed would have significant negative impacts on sedimentation, water quality, and fish habitat in the Rio de los Pinos.

Effects of recommending Rudy (W17f - 1,675 acres) RWMA would be similar to those of not recommending it under alternative 2, except those related to snowmobiling. Because the area is part of an inventoried roadless area, road construction and timber production are currently restricted. Due to the steep and rugged terrain there is little likelihood of development or motorized or mechanized management in most of this area regardless of whether they are explicitly prohibited. However, spruce trees have been severely impacted just to the north by beetle infestation and recommendation would limit any management were that outbreak to expand here. Widespread removal of affected trees to limit infestation spread would likely not be compatible with preserving wilderness characteristics. Not removing affected trees could allow the infestation to spread throughout or beyond the RWMA, leading to widespread tree mortality, loss of canopy cover, and loss of habitat.

There are viewpoints along the Cruces Basin Ridge in the Rudy RWMA where over-snow motorized access would no longer occur. Since over-snow motorized access is essentially the only winter access, no winter access would occur in this area. This would benefit some wildlife that is sensitive to noise from snowmobiles, such as big game. It would provide additional connected habitat and reduce impacts to those species. However, motorized use only ever occurs in a small portion of this area, so the effects in the remainder of the Rudy RWMA would be similar to the effects were it not managed as recommended wilderness and similar to effects under alternative 2.

The Rudy RWMA area currently provides some buffer for the adjacent private lands against fires that might start in the existing wilderness. The Cruces Basin ridge is an advantageous location for suppressing fire were it to leave the wilderness. Given the option, fire suppression activities would most likely occur there rather than mid-slope above the private land. Because aggressive mechanical fuels treatments, or planned prescribed fire would be less likely, recommendation of this area would increase risk from fire to values on private lands to the northeast, especially since prevailing summer winds generally would push fires in that direction.

The addition of Brazos Ridge (W17k1, W17k2, and W17k3 - 2,670 acres) RWMA would effectively extend the Cruces Basin Wilderness north to the Colorado border and the border with the Rio Grande NF. It would limit snowmobile access to several viewpoints into the Cruces Basin and would remove some popular snowmobiling terrain. Motorized use would be more concentrated in other nearby areas, although under alternative 4 all motorized over-snow use is prohibited in the entire San Antonio Management Area, which would likely cause crowding and a worse recreational experience in those areas where over-snow motorized use would still be allowed. Prohibiting motorized use would benefit some wildlife that is sensitive to noise from snowmobiles, such as big game. It would provide additional connected habitat and reduce impacts to those species. Vegetation management would change very little from what it is currently, and effects would be similar. However, spruce trees have been severely impacted just to the north by beetle infestation and an RWMA would limit any management were that outbreak to expand here. Widespread removal of affected trees to limit infestation spread would likely not be compatible with preserving wilderness characteristics. Not removing affected trees could allow the infestation to spread throughout or beyond the RWMA, leading to widespread tree mortality, loss of canopy cover, and loss of habitat.

Mountain bike use would be inconsistent with the Brazos Ridge RWMA area and relocated onto an NFS road open to motor vehicles. The user experience for mountain bikers would be changed from a single-track trail with views of the Cruces Basin to riding on an open dirt road. Recommendation would also break up the experience of a continuous trail for Continental Divide Trail through-bikers.

Recommendation of Olguin (W27a - 7,117 acres) RWMA would limit snowmobile access and would remove some popular snowmobiling terrain. Motorized use would be more concentrated in other nearby areas, though under alternative 4, all motorized over-snow use is prohibited in the entire San Antonio Management Area, which would likely cause crowding and a worse recreational experience in those areas where over-snow motorized use would still be allowed. Prohibiting motorized use would benefit some wildlife that is sensitive to noise from snowmobiles, such as big game. It would provide additional habitat and reduce impacts to those species. Vegetation management would change very little from what it is currently, and effects would be similar. However, spruce trees have been severely impacted just to the north by beetle infestation and an RWMA would limit any management were that outbreak to expand here. Widespread removal of affected trees to limit infestation spread would likely not be compatible with preserving wilderness characteristics. Not removing affected trees could allow the infestation to spread throughout or beyond the RWMA, leading to widespread tree mortality, loss of canopy cover, and loss of habitat.

Mountain bike use along the Continental Divide Trail would be significantly impacted by the Olguin RWMA. It would be inconsistent with the Olguin RWMA section of the trail and relocated onto NFS roads open to motor vehicles. The user experience for mountain bikers would be changed from a single-track trail in a semi-primitive setting to riding on an open dirt road. Continental Divide Trail through-bikers would be required to detour nearly 30 miles on NFS Roads 87 and 93.

Recommendation of Canjilon Meadows (W32a - 6,998 acres) RWMA would limit snowmobile access and would remove some popular snowmobiling terrain. Motorized use would be more concentrated in other nearby areas, which could cause crowding and a worse recreational experience. Prohibiting motorized use would benefit some wildlife that is sensitive to noise from snowmobiles, such as big game. It would provide additional habitat and reduce impacts to those species. The illegal summertime motorized use that currently occurs would likely continue and would be difficult to control because of existing old roads that enter the area and a lack of topographic barriers.

Vegetation management in the Canjilon Meadows RWMA would change very little from what it is currently, and effects would be similar to those under alternative 2. However, significant disease recently necessitated sanitation tree harvest in the area surrounding Canjilon Lakes Campground and spruce trees have been severely impacted by beetle infestation on the Rio Grande NF to the north. Recommendation

would limit any mechanical management of these insect or disease impacts were they to occur in the Canjilon Meadows RWMA. Widespread removal of affected trees to limit infestation spread would likely not be compatible with preserving wilderness characteristics. Not removing affected trees could allow the infestation to spread throughout or beyond the RWMA, leading to widespread tree mortality, loss of canopy cover, and loss of habitat.

Mountain bike use along the Continental Divide Trail would be significantly impacted. It would be inconsistent with the Canjilon Meadows RWMA area and relocated onto NFS roads open to motor vehicles. The user experience for mountain bikers would be changed from a single-track trail in a semi-primitive setting to riding on an open dirt road. Continental Divide Trail through-bikers be required to detour about 10 miles on NFS Roads 274 and 559.

Recommendation of the Canjilon Meadows RWMA would provide additional opportunities for wilderness recreation, especially in this part of the Carson where they are currently rare.

Environmental Consequences for Wilderness – Alternative 5

A total of 67,996 acres of recommended wilderness in 13 RWMAs are included in this alternative. RWMAs included in this alternative are area identified as having wilderness characteristics. They are: McCrystal (Q4g1 and Q4g2), Esther Garcia (Q5n), Jicarita Ridge (C14v1, C14v2, and C14v3), Rio Chiquito (C14x), Cisnero (W29c1 and W29c2), Oso (W29e), Rudy (W17f), Brazos Ridge (W17k1, W17k2, and W17k3), Olguin (W27a), Canjilon Meadows (W32a), Lobo (CrW5b), Huckaby (CrW6c), and Comanche (W21d).

Alternative 5 would add the most recommended wilderness of any alternative. This would provide the most additional primitive recreation opportunities on the Carson and may relieve concentrated use in some areas where wilderness character is impacted. However, more than any other alternative it would displace other uses and would concentrate motorized and mechanized recreation, and their impacts, in other areas. Conflicts among these other non-wilderness recreational uses would be most likely under this alternative.

Some recommended areas would assist in wilderness management where they are adjacent to existing designated wilderness, but the recommended wilderness boundary follows more prominent topographic features than the current boundary (Esther Garcia, Lobo, and Huckaby RWMAs). Wilderness characteristics would be better protected because uses would be better segregated by topography.

The Rio Chiquito, Brazos Ridge, and Rudy RWMAs would make boundary management more difficult because they extend existing designated wilderness boundaries beyond the most prominent topographic feature. Wilderness characteristics would be harder to protect because motorized and mechanized uses would not be separated by topography.

Some areas include frequent fire systems that would be more prone to uncharacteristic, high-severity wildfire because mechanical fuels treatments would be less likely to occur. These areas may experience uncharacteristic tree mortality or effects to soils were a fire to occur. Adjacent infrastructure, cultural resources, and other values at risk may be at higher risk from wildfire because aggressive fuels treatments, such as fuel breaks, that would not appear natural would not be allowed in these areas.

Recommended wilderness would benefit some wildlife species because primitive management would minimize disturbance and provide habitat connectivity. Habitat for some wildlife would be improved because in recommended areas it would not be impacted by vehicle noise. This effect is compounded in the Cruces Basin area because there are multiple recommended areas where snowmobiling would not be allowed. This would concentrate over-snow motorized use into nearby areas. Conversely, limited ability to mechanically treat in these areas may mean that ecological conditions become more departed which could negatively impact wildlife.

The effects of recommending McCrystal (Q4g1 and Q4g2 - 5,365 acres), Cisnero (W29c1 and W29c2 – 2,491 acres), Oso (W29e - 10,000 acres), Rudy (W17f - 1,675 acres), Brazos Ridge (W17k1, W17k2, and W17k3 - 2,670 acres), Olguin (W27a - 7,117 acres), and Canjilon Meadows (W32a - 6,998 acres) RWMAs would be the same as alternative 4.

Effects of recommending the Esther Garcia (Q5n - 1,165 acres) RWMA would be the same as alternative 2.

Effects of recommending Lobo (CcW5b – 82 acres) and Huckaby (CrW6c - 21 acres) RWMAs would be the same as alternatives 2 and 4.

Effects of recommending Jicarita Ridge (C14v1, C14v2, and C14v3 – 12,597 acres) RWMA would mostly be similar to those under alternative 1 in most of the RWMA. Due to steep and rugged terrain and the existing IRA designation for most of the area there is little likelihood of development or motorized or mechanized management or other uses in this area regardless of whether they are explicitly prohibited. The occasional illegal motorized use that occurs on Trail 36 and in the Bear Mountain area would not necessarily be better-controlled by wilderness recommendation since there is not an obvious topographic barrier to prevent it. While mountain biking is currently allowed throughout the area, almost none actually occurs, and the impact of recommendation would be negligible.

Compared to alternative 1, fuels management and fire suppression activities around the Santa Barbara Campground would be affected by recommendation of the Jicarita Ridge RWMA. Mechanical treatment or prescribed burning would be less likely in the dry mixed conifer forests in Santa Barbara Canyon below the campground. Those forests would remain overstocked and departed from desired conditions. High-intensity, stand-replacing fire would be more likely. There are fewer than 700 acres of frequent-fire forests in this area and from a forestwide perspective the effects would be negligible. However, any fire that did occur would likely move up the canyon and threaten infrastructure at the campground and the public. Because the road is one way in/one way out, the public would be at even greater risk. High-intensity fire in this watershed would have significant negative impacts on sedimentation, water quality, and runoff timing in the Rio Santa Barbara, with impacts to downstream communities that are located on the river or use it for irrigation.

The effects of recommending Rio Chiquito (C14x – 2,340 acres) RWMA would be mostly similar to those under alternative 1. Due to the steep and rugged terrain and the existing IRA designation of the area, there is little likelihood of development or motorized or mechanized management or other uses in this area, regardless of whether they are explicitly prohibited. Recommendation would provide more wilderness recreational experiences along Trail 31 and along Trail 100 which does not enter the designated Pecos Wilderness.

Effects of recommending Comanche (W21d – 11,479 acres) RWMA would be mostly similar to those under alternative 1. Due to the steep and rugged terrain and the IRA designation of a portion of the area there is little likelihood of development or motorized or mechanized management or other uses in this area regardless of whether they are explicitly prohibited. Recommendation would provide additional opportunities for wilderness recreation, especially in this part of the Carson where they are rare.

Cumulative Environmental Consequences for Wilderness

The cumulative effects analysis area includes adjoining federally managed lands: Santa Fe NF, Rio Grande NF, and Taos Bureau of Land Management (BLM), all of which also manage wilderness, wilderness study areas, or recommended wilderness.

The Santa Fe and Rio Grande NFs are also currently undergoing plan revision and have both recommended new wilderness areas that would provide for more wilderness opportunities in the surrounding area. In alternatives 4 and 5, wilderness areas would be recommended adjacent to the Santa

Fe NF. Recommended areas in alternatives 2, 4, and 5 would be adjacent to BLM lands identified as having wilderness character. Larger and more connected wilderness provides better opportunities for solitude and unconfined recreation along with other resource benefits.

Three recommended wilderness areas on the Carson NF (Lobo, Jicarita Ridge, and Cisnero) are adjacent to adjoining designated wilderness or wilderness study areas on Bureau of Land Management and the Santa Fe National Forest lands. Lobo shares a boundary with the existing Rio Chama Wilderness Study Area on Bureau of Land Management (BLM), while Cisnero shares a boundary with adjacent San Antonio Wilderness on BLM. Jicarita Ridge shares a boundary with the Santa Fe National Forest portion of the Pecos Wilderness.

With future climate and weather pattern shifts, plants and animals will be vulnerable to the consequences of atypical temperature and rainfall patterns including drought, increased number and intensity of wildfires, increased water stress on vegetation, decreased water yield, and changing runoff patterns. These climate trends are likely to affect the vegetation, water, air quality, and wildlife resources within designated and recommended wilderness areas, which in turn will intensify the risk of ecosystem change in terrestrial and aquatic ecosystems, affecting ecosystem structure, function, and productivity and threatening ecosystem service (Gowda et al. 2018; USDA FS 2010c, 2014a).

Demand for outdoor recreational opportunities, including wilderness recreation, is likely to continue to increase in the future (USDA FS Carson NF 2018a). Rising future temperatures are likely to add to demand for recreational opportunities in cooler, high elevations. Together, these factors would increase wilderness visitation which would increase human impact and detract from apparent naturalness and may impact opportunities for solitude in some areas on the Carson. Under all alternatives, wilderness character would be protected in designated wilderness areas, which may require more intensive management of recreational use in the future.

Wild and Scenic Rivers

Congress passed the National Wild and Scenic Rivers System Act in 1968 (Public Law 90-542: 16 U.S.C. 1271-1287, October 2, 1968) for the purpose of preserving rivers with outstanding natural, cultural, recreational, or other values in a free-flowing condition. Wild and scenic rivers are designated by Congress and are to be protected for the benefit and enjoyment of present and future generations.

Wild and scenic rivers that are eligible for designation must meet the basic criteria for inclusion in the National Wild and Scenic Rivers System. Eligible rivers must be free-flowing and possess at least one value that is outstandingly remarkable on a regional or national level. Outstandingly remarkable value categories include: scenic, recreation, geologic, fish and wildlife, historic, cultural, or other similar values that are a unique, rare, or exemplary feature that is significant when compared with similar values from other rivers at a regional or national scale (FSH 1909.12; 82.73). Designation into the National Wild and Scenic Rivers System preserves rivers in free-flowing condition, and protects water quality, outstandingly remarkable values, and the river's immediate environment for the benefit of present and future generations. The Wild and Scenic Rivers Act defines river classifications on a variety of elements: accessibility, developments along the shoreline, presence or absence of impoundments, and water quality. For management purposes, river segments are classified as wild, scenic, or recreational.

- Wild Rivers – Those rivers or sections of rivers that are free of impoundments and generally inaccessible except by trail, with watersheds or shorelines essentially primitive and water unpolluted.
- Scenic Rivers – Those rivers or sections of rivers that are free of impoundments, with shorelines or watersheds still largely primitive and shorelines largely undeveloped but accessible in places by roads.

- Recreational Rivers – Those rivers or sections of rivers that are readily accessible by road or railroad, that may have some development along their shorelines, and that may have undergone some impoundment or diversion in the past.

Description of Affected Environment

The Carson manages both designated and eligible wild and scenic rivers. The Rio Grande Wild and Scenic River includes approximately 5 miles of the Rio Grande and 4 miles of the Red River where they border the Questa Ranger District. Both segments have a wild designation. Management is conducted jointly with the Taos BLM and follows a BLM comprehensive river management plan. There are 170 miles of river on the Carson that have been identified as eligible for wild and scenic river designation.

Rio Grande National Wild and Scenic River

The Rio Grande National Wild and Scenic River was designated in 1968 as part of the original Wild and Scenic River Act. It includes the Rio Grande Gorge from the Colorado state line to its mouth near Embudo, New Mexico. The lower portion of the Red River is included because it “contributes the only appreciable flow of surface water” within the wild river area and “is deeply entrenched and has characteristics similar to those found in the Rio Grande trench” (U.S. House Document No. 91-174 1969, p 4). The lower 3.25 miles are classified as wild and the remaining 0.75 mile around the state fish hatchery is recreational. Outstandingly remarkable values include cultural and historic, fish and wildlife, geologic, recreational, and scenic.

The public use of the approximately 982 acres contained in the river corridor is managed to preserve the rivers’ natural and primitive condition. In the Rio Grande and lower Red River wild classified sections water quality must meet or exceed State standards for the propagation of fish and for swimming, except where naturally exceeded. In the upper portion of the Red River there are no requirements for water quality prescribed by this designation; however, that segment is used by the State as a trout hatchery and State water quality standards for beneficial uses apply. The management plan says that “pollution of the rivers will be avoided in every way possible.” (US House Document No. 91-174 1969, p 33)

There are no known mining claims in the area. Land within the designated river corridor is withdrawn from all forms of new appropriation under mining law (U.S. Congress 1968, U.S. House Document No. 91-174 1969). The corridor is closed to livestock grazing (U.S. House Document No. 91-174 1969). The range resource within the river corridor is limited and the terrain is rough and rugged. These portions of the La Lama and San Cristobal grazing allotments were not used by domestic livestock at the time of designation. The cutting of trees in the wild portions is generally prohibited. In the recreational portions tree removal, including timber harvest is not prohibited, however most of the area is noncommercial piñon and juniper. There is a limited volume of commercial species are considered noncommercial because of lack of access. Mechanical treatment with chainsaws is permitted to control insect and disease. All ground based motorized travel is prohibited except on existing access roads, and no new roads may be constructed in the wild segment.

Both rivers in this area are popular for trout fishing, particularly the Red River below the fish hatchery. Most recreation in the corridor is day use, with little overnight camping. Trails are maintained to a standard similar to those in designated wilderness and only signs that are essential for public safety are should be installed.

Eligible Wild and Scenic Rivers

During plan revision, the Forest Service is directed to conduct a comprehensive evaluation to determine which rivers on the forest are eligible for inclusion in the National Wild and Scenic Rivers System (FSH 1909.12, ch. 80). The determination of eligibility is based on the river’s free-flowing character and

outstandingly remarkable values that are regionally or nationally conspicuous examples that are among the best representatives of a feature (FSH 1909.12, sec. 82.71 and 82.73). Criteria for outstandingly remarkable values, all analysis documentation, a list of eligible rivers and their classification, and maps are included in appendix G.

There are 51 eligible river segments totaling approximately 170 miles on the Carson. There are 79.7 miles classified as wild, 28.6 miles classified as scenic, and 62.1 miles classified as recreational. Certain protections are applied to eligible rivers until a decision is made as to the future use of the river and adjacent lands through an Act of Congress or a change in eligibility or suitability status from a future study (FSH 1909.12, sec 84.3). The Carson may authorize site-specific projects or activities within eligible river corridors only when that project or activity protects free-flow, the outstandingly remarkable values for which the river is deemed eligible, and the classification of the river. Neither eligibility nor designation by Congress affect existing water rights or the existing jurisdiction of State and Federal Governments as determined by established laws.

Environmental Consequences for Wild and Scenic Rivers

Methodology and Analysis Process

The analysis in this section evaluates the rivers on Carson that are currently designated as wild and scenic rivers and the 51 river segments determined to be eligible for inclusion into the National Wild and Scenic River System. It also describes the potential environmental consequences on the wild and scenic river resource that may result with the adoption of different alternatives in the revised Forest Plan.

Analysis Assumptions

- Management of wild and scenic river resources complies with the 1968 Wild and Scenic Rivers Act. The act was passed to preserve the free-flowing nature of certain selected waterways in America. To be designated, rivers or sections of rivers must be free-flowing and possess at least one outstandingly remarkable value, such as scenic, recreational, geologic, fish, wildlife, historic, cultural, or other feature identified under the act. Additionally, each designated river has a specific comprehensive river management plan that sets forth specific management prescriptions to protect the outstandingly remarkable values. Any proposed water resources project in a designated wild and scenic river, including management activities within the streambed and banks, and below the ordinary high water mark of the river, shall trigger a Section 7 free flow analysis as directed by the Wild and Scenic Rivers Act.
- The number and miles of eligible rivers do not vary by alternative.
- All eligible river segments and associated corridors are managed in compliance with Forest Service Handbook 1909.12, Chapter 84.3 – Interim Protection Measures for Eligible or Suitable Rivers. These guidelines are specific to water resources projects, hydroelectric power, minerals, transportation system, utility proposals, recreation development, motorized travel, wildlife and fish projects, vegetation management, and domestic livestock grazing.
- A suitability study provides the basis for determining which eligible rivers should be recommended to Congress as additions to the National Wild and Scenic Rivers System. If a proposed project has the potential to adversely affect the free-flow or outstandingly remarkable values of an eligible river, the suitability of that river should first be studied before approving the project.
- No suitability studies are being conducted as part of this plan revision.

Environmental Consequences for Wild and Scenic Rivers Common to All Alternatives

Management of the Rio Grande Wild and Scenic River would not vary by alternative and would continue to be managed according to Forest Service policy, Wild and Scenic Rivers Act direction, the current or revised Forest Plan, and the existing comprehensive river management plan. The revised plan states that management of the Rio Grande Wild and Scenic River must comply with the most recent version of the BLM's river management plan. All alternatives would include management direction to protect the outstandingly remarkable values, free-flowing condition, and classifications of wild and scenic river corridors. Maintaining the conditions that characterize wild and scenic rivers would uphold the standards set forth in the Wild and Scenic Rivers Act and would benefit present and future generations through the enjoyment of these areas. Moreover, managing these areas to maintain their free-flowing nature and outstandingly remarkable values would help to protect water quality, scenic integrity, areas of cultural or historic significance, recreational opportunities, and wildlife species health and diversity. There are no other anticipated effects to designated wild and scenic rivers.

Under all alternatives, the identified eligible wild and scenic rivers and their corridors (one-quarter mile on either side of the river) would be managed in accordance with Forest Service Handbook 1909.12, Chapter 82.5. The determination of eligibility constrains the type and manner activities that may occur within the river corridor without first conducting a suitability analysis. Three constraints would apply to activities proposed under any alternative in all eligible river corridors: (1) free-flowing river character must be maintained; (2) identified outstandingly remarkable values must be protected; and (3) the river classification must be maintained (wild, scenic, or recreational).

Effects vary by river classification, eligible wild river corridors being most restrictive and eligible recreational river corridors being the least. For example, the cutting of trees is not allowed in wild classification corridors unless it is necessary for human safety or to protect a cultural value at risk but is acceptable within recreational corridors to meet resource objectives. Additionally, fire (either natural or planned) is acceptable in all eligible wild and scenic river areas to provide for better wildlife habitat or to restore conditions within the natural range of variability. Some activities or infrastructure may be limited (e.g., roads, vegetation management, minerals) or restricted (e.g., hydroelectric power, utility corridors) within wild and scenic river areas to maintain, protect, or enhance river characteristics and outstandingly remarkable values. The specific limitations or restrictions would depend on the specific activity, the river's outstandingly remarkable values and classification, and the results of a suitability determination, if required.

The determination of river eligibility may result in increased public interest and awareness of river resources, leading to increased visitation and potential impacts to the area. As populations increase and more people visit the Carson, the value of managing these areas in their natural, free-flowing condition could increase user satisfaction and contribute to the increased wellbeing of visitors from spending time in these special areas. Conversely, increased visitation to wild and scenic river areas could have some detrimental ecological impacts, such as ground disturbance, increased trash or discarded items, nonnative species introduction or spread, reduced fish populations (through increased fishing pressure), or aquatic habitat degradation.

Cumulative Environmental Consequences for Wild and Scenic Rivers

The intent of the Wild and Scenic Rivers Act is to counteract "the established national policy of dam and other construction", and to "preserve other selected rivers or sections thereof in their free-flowing condition and to protect the water quality of such rivers and to fulfill other vital national conservation purposes" (Wild and Scenic Rivers Act 1968, sec. 1(b)). The Carson manages more water than most adjacent land managers. Taos BLM manages the majority of the Rio Grande Wild and Scenic River. The Santa Fe NF manages the majority of the Chama Wild and Scenic River. The Santa Fe NF to the south and the Rio Grande NF to the north have both identified eligible wild and scenic rivers as part of their

recent plan revisions. Together, these protections of free-flowing rivers in their natural state complement river development that has occurred in many other parts of this landscape, and thereby, fulfills the intent of the Wild and Scenic Rivers Act. The two largest rivers near the Carson are designated under the Act. Many of the smaller nearby rivers that are not designated and are not eligible have been highly modified for centuries by agricultural uses that are a vital part of life in arid northern New Mexico.

Inventoried Roadless Areas

Inventoried roadless areas are a Forest Service administrative designation identified in the 2001 Roadless Area Conservation Rule (Special Areas; Roadless Area Conservation; Final Rule, 66 Fed. Reg. 3243 (January 12, 2001)). Inventoried roadless areas are relatively undisturbed areas that serve as a reference to measure the effects of development on other parts of the landscape. Road construction, road reconstruction, and timber harvest activities are limited to sustain the social and ecological roadless characteristics of each area. These activities are common in many other portions of forests and grasslands across the Nation but are restricted in inventoried roadless areas because they have the greatest likelihood of altering landscapes, causing significant landscape fragmentation, and resulting in immediate and long-term loss of roadless characteristics (USDA FS 2000). Other activities that may compromise roadless area values are not permitted or restricted as part of the Roadless Area Conservation Rule as they are best reviewed by local land management planning (USDA FS 2000).

In 2000, the Forest Service completed an inventory of NFS lands that had been identified as roadless for planning purposes. This inventory was based on existing plans, plan revisions in progress where the agency had established a roadless inventory, or other assessments completed and adopted by the agency, including the Roadless Area Review and Evaluation (RARE) II inventory (USDA FS 2000). Under the 2001 Roadless Area Conservation Rule, these areas were designated as inventoried roadless areas and are managed to preserve their roadless character. As defined by the 2001 Roadless Area Conservation Rule the following values or features often characterize inventoried roadless areas:

1. high quality or undisturbed soil, water, and air;
2. source of public drinking water;
3. diversity of plant and animal communities;
4. habitat for threatened, endangered, candidate, proposed and sensitive species on large areas;
5. natural appearing landscapes with high or very high scenic integrity;
6. primitive, semi-primitive non-motorized and semi-primitive motorized recreation opportunity spectrum classes of dispersed recreation;
7. reference landscapes;
8. traditional cultural properties and sacred sites; and
9. other locally identified unique characteristics.

Inventoried roadless area boundaries were not reconsidered during this plan revision process and inventoried roadless areas on the Carson do not differ among alternatives.

Description of Affected Environment

The Carson has 12 inventoried roadless areas totaling 105,331 acres. The Columbine-Hondo Inventoried Roadless Area (43,738) has subsequently been included in the Columbine-Hondo Wilderness, in its entirety. Portions of the Wheeler Peak Inventoried Roadless Area have been subsequently included in the

Wheeler Peak Wilderness, though the inventoried roadless area boundary has not been adjusted. The most restrictive management direction applies when designated areas overlap. Following existing regulation and policy, with some exceptions, the Chief of the Forest Service reviews projects involving road construction or reconstruction and the cutting, sale, or removal of timber in an inventoried roadless area. Any such projects not reviewed by the Chief are reviewed by the Regional Forester.

Environmental Consequences for Inventoried Roadless Areas

Methodology and Analysis Process

Effects of the various alternatives on inventoried roadless areas were evaluated based on how plan direction under each alternative would protect the roadless character of these areas.

Assumptions

- Activities in inventoried roadless areas under all alternatives would be consistent with the 2001 Roadless Area Conservation Rule in order to maintain their roadless characteristics.

Environmental Consequences for Inventoried Roadless Areas Common to All Alternatives

No new inventoried roadless areas are proposed under any alternative. Under all alternatives inventoried roadless areas would be managed in accordance with current regulation and policy. Activities within inventoried roadless areas must follow the 2001 Roadless Area Conservation Rule and current Forest Service policy on road construction and timber cutting, sale, and removal, consistent with national Forest Service policy on preserving roadless character. Inventoried roadless areas would be managed to protect their roadless character. Inventoried roadless areas would provide clean drinking water and function as biological strongholds for populations of threatened and endangered species. They would provide large, relatively undisturbed landscapes that are important to biological diversity and the long-term survival of many at-risk species. Inventoried roadless areas would continue to provide opportunities for dispersed outdoor recreation as those opportunities diminish elsewhere when open space and natural settings are developed. They also serve as bulwarks against the spread of nonnative invasive plant species and provide reference areas for study and research.

Environmental Consequences for Inventoried Roadless Areas - Alternative 3

Alternative 3 expands the Sipapu Developed Winter and Summer Resort Management Area by 921 acres. Approximately 890 of those acres overlap the Comales Canyon Inventoried Roadless Area. Any development or use in this management area would be consistent with the more restrictive inventoried roadless area plan components including limitations on timber harvest and road construction and requirements to maintain recreation settings and high scenic integrity. Consistent with Forest Service roadless area policy and after appropriate regional forester reviews, tree cutting may occur incidental to other non-prohibited management activities and mechanical fuel treatments could be permitted. Trees may be cut for stewardship purposes that maintain or improve one or more roadless characteristics, while focusing on improving threatened, endangered, proposed, or sensitive species habitat; reducing the risk of uncharacteristic wildfire; or restoring ecological structure, function, processes, and composition (USDA FS 2000).

Any project in inventoried roadless areas including any management in the Sipapu Developed Winter and Summer Resort Management Area would have to be designed and built without road construction or reconstruction and without timber harvesting unless that harvesting would maintain or improve one or more roadless area characteristics and achieved stewardship purposes or was incidental to other non-prohibited management activities such as mechanical fuel treatment or administrative use. That likely

would severely restrict the types of ski area development that would be possible. Were ski area expansion to occur into the expanded Developed Winter and Summer Resort Management Area where it overlaps an inventoried roadless area, it may have minor impacts on species habitat and scenic character but would still be required to maintain both. That is, the roadless characteristic of quality of habitat may be degraded by decreasing the amount of available habitat, decreasing habitat connectivity, increasing ground disturbance, and increasing human intrusive disturbance. Some very high-quality scenery and scenery with natural-appearing landscapes would be degraded to high-quality.

Cumulative Environmental Consequences for Inventoried Roadless Areas

Other adjacent land managers that maintain roadless areas including wilderness and wilderness study areas include other national forests, tribes, the U.S. Bureau of Land Management, the Colin Nesblett and Elliot Barker State Wildlife Areas, and portions of the Philmont Scout Ranch. Roadless character of inventoried roadless areas with the cumulative effects analysis area would be maintained or enhanced through Forest Service or other agency regulation and policy. Other agencies and adjacent forests may also recommend portions of inventoried roadless areas as wilderness or wilderness study areas resulting in cumulative effects that protect roadless character and associated benefits such as, undisturbed soil, water, and air; public drinking water sources; plant and animal diversity; wildlife habitat; primitive and semi-primitive recreation; reference, relatively undisturbed landscapes; high scenic quality; and protection of traditional cultural properties.

National Scenic, Historic, and Recreation Trails

The National Trails System is the network of scenic, historic, and recreation trails created by the National Trails System Act of 1968 (Pub. L. 90–543). These trails provide for outdoor recreation needs, promote the enjoyment, appreciation, and preservation of open-air, outdoor areas and historic resources, and encourage public access and citizen involvement.

The National Trails System Act identifies three categories of trails as part of the national trails system:

- Recreation – Trails that provide a variety of outdoor recreation uses in or reasonably accessible to urban areas. Recreation trails are designated by the Secretary of the Interior or the Secretary of Agriculture.
- Scenic – Extended trails located to provide for maximum outdoor recreation potential and for the conservation and enjoyment of the nationally-significant scenic, historic, natural, or cultural qualities of the areas through which such trails may pass. Scenic trails are designated by Congress.
- Historic – Extended trails which follow as closely as possible and practicable the original trails or routes of travel of national historic significance. National historic trails shall have as their purpose the identification and protection of the historic route and its historic remnants and artifacts for public use and enjoyment. Historic trails are designated by Congress.

Description of Affected Environment

The Carson is home to three national recreation trails and portions of one national scenic and two national historic trails.

Columbine-Twining National Recreation Trail

The Columbine-Twining National Recreation Trail was designated in 1978 (USDA FS Carson NF 2015c). It is a difficult 14.2-mile trail through Columbine Canyon to the ridge of Rio Hondo Canyon on the Questa Ranger District (see plan appendix A, figure A-7). The trail offers hiking through aspens to exceptional views of Lobo Peak and Flag Mountain above tree line.

South Boundary National Recreation Trail

Designated in 1982, the South Boundary National Recreation Trail is 22 miles long and offers various summer and winter trail opportunities from Taos to Angel Fire, New Mexico, on the Camino Real Ranger District (see plan appendix A, figure A-7) (USDA FS Carson NF 2015a). The trail is at its very best in the fall, when aspens along the route turn shades of yellow, gold, and fiery orange. Besides being a wonderfully scenic tour of New Mexico's Rocky Mountains, this is also one of the state's best mountain bike rides.

Jicarita Peak National Recreation Trail

The Jicarita Peak National Recreation Trail was designated in 1979 (see plan appendix A, figure A-7) (USDA FS Carson NF 2015a). It offers a challenging experience in the Pecos Wilderness and spectacular views from atop Jicarita Peak (12,835 feet) on the Camino Real Ranger District. The trail is 23 miles long and ranges in elevation from 8,860 to 12,835 feet. The trail is open for hiking, fishing access, horseback riding, and other non-motorized uses.

Continental Divide National Scenic Trail

Designated by an Act of Congress in 1978, the Continental Divide National Scenic Trail traverses the Rocky Mountains from Canada to Mexico for approximately 3,100 miles (USDA FS Carson NF 2015a). The Continental Divide National Scenic Trail navigates dramatically diverse ecosystems through mountain meadows, granite peaks, and high-desert surroundings. It is one of the most renowned trails in the United States, for its scenic beauty, recreational opportunities, elevation gains, and primitive character. The Carson has completed 69.8 miles and surveyed 35 miles of the Continental Divide National Scenic Trail for improvement (see plan appendix A, figure A-7) on the Tres Piedras, El Rito, and Canjilon Ranger Districts.

Old Spanish National Historic Trail

Congress designated the Old Spanish National Historic Trail in 2002 (see plan appendix A, figure A-7) (USDI NPS 2015). The trail crosses six states (Arizona, California, Colorado, Nevada, New Mexico, and Utah) and was primarily a horse and burro pack route between Santa Fe and Los Angeles, which developed partly from a network of American Indian and Hispanic trade routes in the 1800s (USDI NPS 2015). The entire trail (with various loops) transverses 2,700 miles, with 49.6 of those miles on the Camino Real Ranger District.

Environmental Consequences for National Scenic, Historic, and Recreation Trails

Methodology and Analysis Process

Effects of the alternatives to nationally designated trails were evaluated by comparing the plan direction of each alternative toward meeting the nature and purpose of these routes and protecting their historic, recreation, and scenic qualities. The most important management tool and metric associated with designated trails is the National Trails System Act of 1968. Numerous requirements in the National Trails System Act must be met to comply with the intent of the law. Scenic and historic trails are required to have a comprehensive trail management plan (P.L. 90-543, as amended through P.L. 111-11, 2009). These plans are developed by the trail's administering agency and provide a framework for managing and allocating uses along the trails. Additional management tools and metrics used to manage designated trails include the scenery management system and recreation opportunity spectrum.

Analysis Assumptions

- Management under all alternatives would be consistent with a designated trail's comprehensive management plan.
- Recreation opportunity spectrum classes may vary considerably depending on the alignment of the trail and its proximity to roads. However, trails are primarily non-motorized and most often classified as Semi-Primitive Non-Motorized or Primitive.
- For alternative 1, the visual quality objectives identified in the 1986 Forest Plan and other Plan direction would be used to manage scenery. Similar to the scenery section, to describe and compare consequences, this analysis uses scenery management system terminology (scenic integrity objectives) for all alternatives.
- Retention visual quality objective is equivalent to high scenic integrity objective; preservation visual quality objective is equivalent to very high scenic integrity objective.

Indicators

- meeting the nature and purpose of the trail through plan direction;
- scenic integrity objective allocations within each designated trail corridor; and
- a qualitative discussion of the potential effects to scenic resources from vegetation management activities.

Environmental Consequences for National Scenic, Historic, and Recreation Trails Common to All Alternatives

No new nationally designated trails are proposed in any alternative. The comprehensive plans for the Continental Divide National Scenic Trail and national historic trails along with corresponding directives guide management in implementing the National Trails System Act for these trails under all alternatives. Establishment reports for national scenic, historic and recreation trails would continue to guide management under all alternatives. The current nationally designated trails would continue to be managed to protect the values for which they were designated and provide opportunities to view natural features and scenery, in addition to recreational opportunities in a variety of recreation opportunity spectrum settings (DA-NTRL- DC 1, 2, 3, 8, and 12).

Multiple-use management activities may affect scenic resources viewed from nationally designated trails under all alternatives. Effects of other multiple-use management on scenic resources can be found in the [Scenery resource section](#) of the FEIS. There is potential to impact scenic integrity as viewed from designated trails as a result of proposed vegetation management activities, particularly activities with mechanical treatments, under all alternatives. In the short term, restoration activities completed with mechanical treatments may alter scenic resources visible from the designated trails through changing forest stands from closed forests to more open forests and from residual stumps and soil disturbance. In the long term, vegetation treatments may improve scenery by creating vistas, promoting healthy vegetation, and improving ecosystem resilience to uncharacteristic disturbances. Prescribed fire activities typically have effects in the short term with benefits occurring within a few years. While some short-term impacts may occur, scenic integrity objectives would still be met, particularly in the long term. More detailed effects can be found in the Scenic Resources section of the FEIS.

Environmental Consequences for National Scenic, Historic, and Recreation Trails – Alternative 1

Current management direction under the 1986 Forest Plan would continue. Nationally designated trails pass through a variety of management areas and different scenic resources. The 1986 Forest Plan includes plan components for the Continental Divide National Scenic Trail to protect the scenic qualities along the trail and implement standards of trail signing and maintenance along the route corridor. No other designated trail is specified in the 1986 Forest Plan.

For most trails, the management area emphasis along with other plan components provide sufficient direction to protect the nature and purpose of the trail with associated effects. More site-specific project planning and mitigation may be needed where the emphasis of the management area and the nature and purpose of the trail are not aligned (such as a timber-emphasis management area and a national scenic trail). There would be no change in current direction for any designated trail under alternative 1 and some trails are not specifically mentioned in the 1986 Forest Plan (such as the national historic trails). Alternative 1 provides the least comprehensive management of any alternative. Under this alternative national scenic, historic and recreation trails would continue to be managed for moderate to high scenery integrity objectives.

The 1986 Forest Plan does not include any objectives that direct specific amounts of vegetation treatment, either mechanically or with prescribed fire. Vegetation management both mechanically or with prescribed fire would continue within the views of designated trails with both short-term effects and long-term benefits to meet the high and very high SIOs in foreground views and moderate SIO in some foreground views.

Environmental Consequences for National Scenic, Historic, and Recreation Trails Common to Alternatives 2, 3, 4, and 5

Each nationally designated trail is included in the plan as a designated area with specific plan components in alternatives 2, 3, 4, and 5 including desired conditions that conflicts among users are rare and easily resolved. Action alternatives include specific plan components for each type of trail designation to align with the nature and purpose of the trail. Designated area plan components include comprehensive direction for: Continental Divide National Scenic Trail, national historic trails, and national recreation trails. Desired conditions, objectives, standards, and guidelines align management direction with the nature and purpose of each trail and any applicable comprehensive plans and establishment reports for national recreation trails. All action alternatives provide more comprehensive direction than alternative 1. The management direction causes the best management and protection of the scenic, recreation, cultural and historic qualities of the nationally designated trails and the associated effects (DA-NTRL- DC 1, 2, 3, 8, and 12).

Alternatives 2, 3, 4, and 5 include plan components that emphasize natural-appearing scenery, managing for natural-appearing scenery in foreground views including high or very high SIOs and moderate SIO in middleground views of national recreation trails (DA-NTRL-DC 2, 3, 11, and 12). Very high SIOs occur when the trail passes through designated or recommended wilderness. Forestwide guidelines include meeting scenery objectives as identified on the Scenic Integrity Objective Map (FW-SCEN-G-2). With more comprehensive plan direction, opportunities to protect and enhance trail qualities are anticipated with beneficial effects of connecting people with nature and enhancing natural settings (DA-NTRL-DC-1, 8, DA-NTRL-S- 1). A greater amount of beneficial effects occur in action alternatives when compared to alternative 1 due to the comprehensive plan direction.

Environmental Consequences for National Scenic, Historic, and Recreation Trails - Alternatives 2 and 5

Alternatives 2 and 5 have objectives to accomplish vegetation treatments using both mechanical treatments and prescribed fire. Stretches of these trails lie within designated wilderness, where mechanical treatment is prohibited; no mechanical treatments are anticipated in very high SIO areas. Vegetation management both mechanically or with prescribed fire would continue within the views of designated trails with both short-term effects and long-term benefits to meet the high SIO in foreground views. Alternatives 2 and 5 have guidelines that visual impacts from management activities and infrastructure should meet scenery objectives as identified on the Scenic Integrity Objective Map. Where high SIO is assigned beyond the foreground distance, the benefits of implementing vegetation management to meet the Scenic Integrity Objective Map would occur throughout a trail corridor viewshed.

Environmental Consequences for National Scenic, Historic, and Recreation Trails – Alternative 3

Effects of alternative 3 would be similar to alternative 2. Alternative 3 would treat the most acres mechanically, per vegetation management objectives, and potentially have the most amount of short-term impact for these types of activities if restoration treatments occur in trail corridor viewsheds. However, visual impacts of management activities would be designed to meet the Scenic Integrity Objective Map.

Environmental Consequences for National Scenic, Historic, and Recreation Trails – Alternative 4

Effects of alternative 4 would be similar to alternative 2. Alternative 4 would have the least amount of mechanical treatment, per vegetation management objectives, and therefore, the least amount of short-term impact for these types of activities. Alternative 4 would have more prescribed fire treatments with more short-term impacts and benefits occurring within a few years since landscapes typically recover quickly with the effects of prescribed fire being less noticeable than the effects of mechanical treatments.

Cumulative Environmental Consequences for National Scenic, Historic, and Recreation Trails

The cumulative effects analysis timeframe is the next 10 to 15 years and the area is the Carson National Forest, the lands adjacent to and within the Carson under other ownership within about 10 miles. No cumulative effects are expected for national recreation trails as they are located entirely within the Carson. The longer distance designated trails (Continental Divide National Scenic Trail and national historic trails) pass in and out of NFS lands and settings and landscapes may change rather abruptly from undeveloped, natural settings to developed, rural or urban settings. Since most private lands and other ownerships do not have the same regulations for natural resource management, the effects of ongoing developments or activities next to or within NFS land boundaries can sometimes be quite noticeable when viewing the continuous landscape, potentially affecting the visitor's satisfaction and quality of their experience on a long-distance designated trail.

Comprehensive management plans for nationally designated scenic and historic trails are developed to guide management along the entire length of a trail and to protect and enhance the nature and purpose for which the trail was designated including historic, scenic, and recreational qualities across ownership boundaries, reducing any negative cumulative consequences. The cumulative environmental consequences of proposed management efforts in the context of the larger cumulative effects analysis area though comprehensive management plans would contribute to the movement of designated trail values toward desired conditions. Ultimately, movement toward desired conditions for designated trails would

provide tourism benefits for the region and communities they traverse and contribute to sustainable social and economic systems.

National Scenic Byways

The National Scenic Byways Program is administered by the U.S. Department of Transportation, Federal Highway Administration. The program was established to help recognize, preserve, and enhance selected roads throughout the Nation. The U.S. Secretary of Transportation recognizes roads designated as a national scenic byway through this program based on one or more intrinsic qualities—archaeological, cultural, historic, natural, recreational, or scenic (US DOT 2018). National scenic byways provide tourism benefits for the region and communities they traverse.

In addition to the National Scenic Byways Program described above, the Chief of the Forest Service, U.S. Department of Agriculture, can designate routes traversing NFS lands as national forest scenic byways. National forest scenic byways connect the American public to some of this country's most spectacular landscapes within public lands. They are the gateways to access attractions such as hiking trails, overlooks, historic sites, and wilderness areas (US DOT 2018).

Description of Affected Environment

The Enchanted Circle Scenic Byway is the only national scenic byway within the Carson NF. The Enchanted Circle Scenic Byway is an 84-mile loop of scenic driving from Taos, through Questa, Red River, Angel Fire, and back to Taos (NM Enchanted Circle 2015; US DOT 2018; USDA FS Carson NF 2015a).

Scenic byways pass through multiple ownerships with settings, through diverse landscapes, all of which contribute to one or more of a scenic byway's intrinsic qualities—archaeological, cultural, historic, natural, recreational, or scenic. The National Scenic Byways Program requires a corridor management plan for scenic byway designation. A corridor management plan is a written plan developed by the communities along a scenic byway that outlines how to protect and enhance the byway's intrinsic qualities and character that define the byway corridor. Plans are usually flexible “living documents” that outline the goals, strategies, and responsibilities for preserving and promoting the byway. This is especially true of the Enchanted Circle Scenic Byway, which has outstanding scenery, offers various recreation opportunities, and showcases the unique cultural history of northern New Mexico. Together, the Town of Taos, Village of Taos Ski Valley, Village of Questa, Town of Red River, Village of Eagle Nest, and Angel Fire Convention and Visitor's Bureau have formed a marketing cooperative to promote the Enchanted Circle Scenic Byway as an extended stay opportunity for visitors in the area, as well as to stimulate visitation to each of the communities along its route and within the region.

Environmental Consequences for National Scenic Byways

Methodology and Analysis Process

Effects of the various alternatives to scenic byways were evaluated by comparing the plan direction of each alternative toward protecting the intrinsic qualities of these routes. The primary management tool and metric associated with scenic byways is the scenery management system to manage, maintain, and improve the viewshed associated with the byway (see also [Scenery](#)).

Analysis Assumptions

- Scenic byways are designated to showcase the intrinsic qualities intrinsic qualities—archaeological, cultural, historic, natural, recreational, or scenic—of the area while adding to its economic well-being.

- Management under all alternatives would be consistent with the scenic byway corridor management plan or interpretive master plan.
- The 1986 Forest Plan does not have not specific management direction on how to manage scenic byways so this assumption was developed based on the information found in the 1986 Plan. Under alternative 1, it is assumed that the foreground of scenic byways would be managed for retention visual quality objective, since they are a “high use road.” “Areas viewed in the foreground from communities, recreation areas, and high use roads and waterbodies, as well as scenic backdrops from these areas, will have an objective of Retention. There, management activities will not be visually evident within one year of project completion (USDA FS Carson NF 1986). Regardless of the management area emphasis in alternative 1, it is assumed the views from scenic byways would be managed with a scenery emphasis.
- For alternative 1, the visual quality objectives identified in the 1986 forest plan and other plan direction would be used to manage scenery. Similar to the scenery section, to describe and compare consequences, this analysis uses scenery management system terminology (scenic integrity objectives) for all alternatives.
- Retention visual quality objective is equivalent to high scenic integrity objective.

Indicators

The following indicators were used in this evaluation:

- protecting the intrinsic qualities of scenic byways through plan direction;
- scenic integrity objective allocations within each scenic byway corridor ([Scenery](#)); and
- a qualitative discussion of the potential effects to scenic resources from vegetation management activities.

Environmental Consequences for National Scenic Byways Common to All Alternatives

No new scenic byways are proposed for any alternative. Corridor management plans and the interpretive plan for the national forest scenic byway would also guide management of scenic byways under all alternatives. The current scenic byways would continue to be managed to protect the values for which they were designated (scenic byway intrinsic qualities—archaeological, cultural, historic, natural, recreational, or scenic) and provide opportunities to drive for pleasure and view natural features and scenery. Scenic byways would continue to provide tourism and economic benefits for the region and communities they traverse.

Multiple-use management activities affect scenic resources viewed from scenic byways. This section focuses on the consequences of vegetation management since that is the management activity scenic byway users would notice the most. Effects of other multiple use management on scenic resources can be found in the Scenic Resources section of the FEIS ([Scenery](#)).

There is potential to impact scenic integrity as viewed from scenic byways as a result of proposed vegetation management activities, particularly activities with mechanical treatments, under all alternatives. In the short term, restoration activities completed with mechanical treatments may alter scenic resources visible from the scenic byways through changing forest stands from closed forests to more open forests and from residual stumps and soil disturbance. In the long term, vegetation treatments may improve scenery by creating vistas, promoting healthy vegetation, and improving ecosystem resilience to uncharacteristic disturbances. Prescribed fire activities typically have effects in the short term with benefits occurring within a few years. While some short-term impacts may occur, scenic integrity

objectives would still be met, particularly in the long term. More detailed effects can be found in the Scenic Resources section of the FEIS ([Scenery](#)).

Environmental Consequences for National Scenic Byways – Alternative 1

Alternative 1 does not include specific plan components for scenic byways and provides the least direction for scenic byway management of all the alternatives. Scenic byway corridor management plans would provide management guidance for scenic byways with associated effects.

Scenic quality would be managed in accordance with the high scenic integrity objective using the analysis assumption that the foreground from high use roads would be managed for high scenic integrity objective. Current visual resource maps or management area direction may not accurately show these areas as high SIO if the scenic byway designation occurred after the release of the 1986 Forest Plan.

The 1986 Forest Plan does not include any objectives that direct specific amounts of vegetation treatment, either mechanically or with prescribed fire. Vegetation management both mechanically or with prescribed fire would continue within the views of scenic byways with both short-term effects and long-term benefits as discussed in effects common to all.

Environmental Consequences for National Scenic Byways Common to Alternatives 2, 3, 4, and 5

In alternatives 2, 3, 4, and 5, scenic byways are included as a designated area with specific plan components. The plan components within this designated area do not change between alternatives. Potential impacts to scenic integrity as viewed from scenic byways may differ between action alternatives as a result of proposed vegetation management activities objectives.

The action alternatives provide more comprehensive direction than alternative 1. The management direction causes the best management and protection of scenic byways and the associated effects.

Desired conditions and guidelines in alternatives 2, 3, 4, and 5 emphasize natural-appearing scenery, managing for high scenic integrity objective, and meeting scenery objectives as identified on the Scenic Integrity Objective Map. Management approaches emphasize working with other agencies, highway departments, and communities to improve scenery, services, and interpretive opportunities. With more comprehensive plan direction, opportunities to preserve and enhance scenic byway intrinsic qualities are anticipated with beneficial effects of connecting people with nature and enhancing natural settings. A greater amount of beneficial effects occur in the action alternatives when compared to alternative 1 due to the comprehensive plan direction.

Environmental Consequences for National Scenic Byways - Alternatives 2 and 5

Alternatives 2 and 5 have objectives to accomplish vegetation treatments using both mechanical treatments and prescribed fire. Alternatives 2 and 5 propose a rate of mechanical treatment (27,500 to 60,000 acres during each 10-year period) and a rate of wildland fire (100,000 to 165,000 acres during each 10-year period). Vegetation management both mechanically or with prescribed fire would continue within the views of scenic byways with both short-term effects and long-term benefits to meet the High SIO in foreground views. Alternative 2 has a guideline that visual impacts from management activities and infrastructure should meet scenery objectives as identified on the Scenic Integrity Objective Map. Where high SIO is assigned beyond the foreground distance, the benefits of implementing vegetation management to meet the Scenic Integrity Objective Map would occur throughout a scenic byway viewshed.

Environmental Consequences for National Scenic Byways – Alternative 3

Effects of alternative 3 would be similar to alternatives 2 and 5. Alternative 3 would treat the most acres mechanically, per vegetation management objectives, and potentially have the most amount of short-term impact for these types of activities if restoration treatments occur in scenic byway viewsheds. However, visual impacts of management activities would be designed to meet the Scenic Integrity Objective Map.

Environmental Consequences for National Scenic Byways – Alternative 4

Effects of alternative 4 would be similar to alternatives 2 and 5. Alternative 4 would have the least amount of mechanical treatment, per vegetation management objectives, and therefore, the least amount of short-term impact for these types of activities. Alternative 4 would have more prescribed fire treatments with more short-term impacts and benefits occurring within a few years since landscapes typically recover quickly with the effects of prescribed fire being less noticeable than the effects of mechanical treatments.

Cumulative Environmental Consequences for National Scenic Byways

The cumulative effects analysis timeframe is the next 10 to 15 years. The spatial extent of the cumulative effects analysis for scenic byways is the Carson NF, private inholdings, and lands adjacent to the Carson within about 10 miles. Scenic byways pass in and out of NFS lands and settings may change rather abruptly from undeveloped, natural settings to developed, rural or urban settings. Since most private lands and other ownerships do not have the same regulations for natural resource management, the effects of ongoing developments or activities next to or within NFS land boundaries can sometimes be quite noticeable when viewing the continuous landscape potentially affecting the visitor's satisfaction and quality of their experience on a scenic byway. Forest visitors often view natural resources as a continuous landscape with little discernment regarding the land ownership being viewed. If activities on other ownerships and private lands are designed to lessen impacts to natural resources, including scenery, the difference between private lands, other ownerships, and NFS lands are less apparent.

Corridor management plans for scenic byways are developed to protect and enhance the byway's intrinsic qualities and character that define the byway corridor, helping promote the management and value of a scenic byways intrinsic qualities across ownership boundaries, reducing any negative cumulative consequences. The cumulative environmental consequences of proposed management efforts in the context of the larger cumulative effects analysis area though corridor management plans would contribute to the movement of scenic byway values toward desired conditions. Ultimately, movement toward desired conditions for scenic byways would provide tourism benefits for the region and communities they traverse and contribute to sustainable social and economic systems.

Wild Horse Territories

The Wild Free-Roaming Horses and Burros Act of 1971, as amended by the Federal Land Policy and Management Act of 1976 and the Public Rangeland Improvement Act of 1978, directs the protection and management of wild horses and burros on public lands. The Secretaries of Interior or Agriculture may designate and maintain specific ranges on public lands to manage wild horses and burros. The Forest Service, by authority of the Secretary of Agriculture, is responsible for managing the nation's wild horses and burros on NFS lands.

Management of wild horse and burro territories on the Carson is guided by individual management plans in coordination with the BLM and other affected land management agencies. A census of wild horses and burros on NFS lands is taken every 3 to 4 years to assess population size and growth rate, and genetic monitoring is used to establish health of the population and historic origins. Since wild horse populations can double approximately every 5 years (18 percent recruitment rate), horses in excess of what the

ecosystem can sustain are periodically gathered and removed from wild horse territories. This helps achieve appropriate management levels and herd and ecosystem health, mitigating potential overgrazing and facilitating co-existence among multiple grazing species. In accordance with the 1976 Adopt-A-Horse program and the 1978 Public Rangelands Improvement Act, captured animals are adopted out if possible. Titles are transferred to adopters after one year, provided the animals have received proper and humane care and treatment during that time.

Description of Affected Environment

The Carson has four designated wild horse territories, but only two are occupied and managed: Jarita Mesa Wild Horse Territory and Jicarilla Wild Horse Territory (see plan appendix A, figure A-8).

The 75,986-acre Jicarilla Wild Horse Territory on the Jicarilla Ranger District has an appropriate management level of 50 to 105 horses (2004 decision). Just to the west on public lands, the Bureau of Land Management (BLM) has the 8,019-acre Carracas Mesa Herd Area. The appropriate management level for this herd area is 23 horses. Currently, the Jicarilla Wild Horse Territory and the Carracas Mesa Herd Area are managed jointly. Together they are called the Jicarilla Joint Management Area and have an appropriate management level of 73 to 128 horses. The BLM is in the process of analyzing its herd area's appropriate management level and is proposing not to change it. In April 2015, the population for the Jicarilla Joint Management Area was estimated to be between 342 and 502 horses. A fertility control program for the Jicarilla herd has been reinstated in the last two years. About 60 percent of the mares have only been treated with a primer dose of the Porcine Zona Pellucida (PZP) vaccine, an immune-contraceptive treatment, while the other 40 percent have been treated with a dose of PZP22, which includes time released pellets and does not require a primer. Over 100 mares have been inoculated, but further study is needed to determine the success of this program.

The 23,882-acre Jarita Mesa Wild Horse Territory and 31,010-acre Herd Use Area (54,889 acres total) on the El Rito Ranger District has an appropriate management level of 20 to 70 horses (2002 decision). In December 2014, the population for the Jarita Mesa Wild Horse Territory was estimated to be 163 horses. Reproduction for this herd is usually at about 15 to 20 percent, but is currently estimated to be only 10 to 15 percent, because of the aggressive fertility control program that has been in place for approximately 5 years and the harsher terrain and environment on the Jarita Mesa Wild Horse Territory tends to produce a lower foaling rate than the Jicarilla herd. The numbers for the Jarita Mesa herd are firmer than those on the Jicarilla herd. The PZP mares have been followed and their foaling rates have been the subject of in-depth studies by interns from Cummings School of Veterinary Medicine at Tufts University.

Since 2003, there have been ongoing efforts to gather and adopt wild horses off these territories. The intent of the gathers is to reduce the current wild horse populations to the approved appropriate management level. The removals have not kept pace with the reproduction rates of either herd. Situations such as weather delays and less adoption demand have led to the gathering of fewer horses. More bait trapping removal is planned over the next several years.

Wild horses and burros are an important social and cultural ecosystem service in the Carson NF. The history of the wild horse territories is tied to that of local communities, and many Americans from all backgrounds have an emotional attachment to wild horses as cultural symbols. Wild horse territories help protect and preserve traditions and values surrounding wild horses.

Environmental Consequences for Wild Horse Territories

Methodology and Analysis Process

Effects from the alternatives to wild horse territories will be evaluated by comparing the plan direction of each alternative toward the protection and management of wild horses and burros.

Analysis Assumptions

- Management of active wild horse and burro territories is guided by individual management plans.

Indicators

- Protection and management of wild horses and burros through plan direction

Environmental Consequences for Wild Horse Territories Common to All Alternatives

No new wild horse territories are proposed for any alternative. All alternatives would continue to manage the Jarita Mesa Wild Horse Territory and Jicarilla Wild Horse Territory according to the individual management plans and as provided by law and Forest Service policy. All alternatives would provide plan direction through various plan components (desired conditions, standards, or guidelines) on managing wild horse territories. Under all alternatives, the combined management direction would protect and manage wild horse and burro territories to provide a biologically sound and genetically viable horse population that is supported by healthy ecosystems, essential ecological processes, and land stewardship activities, and reflect the diversity, quantity, quality, and capability of natural habitats (DA-WHT-DC 1).

Vegetation restoration activities would occur with all alternatives. Restoration activities may be either mechanical treatments or prescribed fire and naturally ignited wildfire. The restoration activities are focused on frequent fire conifer systems, but some treatments may occur in non-forested vegetation to reduce encroachment into meadows and increase grass and forb abundance. Restoration treatments under all alternatives may indirectly affect the wild horse territories by improving conditions of the range resource and providing increased forage for livestock grazing as well as wild horses and burros in designated territories (DA-WHT-DC 2). Objectives to remove, improve, or reconstruct wildlife and range improvement infrastructure under all action alternatives may indirectly affect wild horse territories by managing or changing the areas of use of both livestock and wild horses and burros. If these changes reduce competition for forage, wild horse territories are protected and enhanced (DA-WHT-DC 2).

Environmental Consequences for Wild Horse Territories – Alternative 1

Alternative 1 would continue to protect and improve wild horse habitat. This alternative would continue to manage wild horse territories on the Carson by individual management plans in coordination with the BLM and other affected land management agencies.

Environmental Consequences for Wild Horse Territories Common to Alternatives 2, 3, 4, and 5

Wild horse territories are included in the plan and other action alternatives as a designated area with specific plan components. Desired conditions of these plan components emphasize biologically sound and genetically viable horse populations; healthy ecosystems; resilient rangelands; and healthy, persistent forage, browse and cover needs for wild horses, wildlife, and authorized livestock. A standard for any of these action alternatives would require humane methods be used to gather animals when acceptable management levels are exceeded. A guideline to align horse numbers within active territories to the wild horse territory management plan are included, making the plan direction more adaptive to the most current management plan. Inactive territories would be managed for an appropriate management level of zero horse or burro. Any of the action alternatives would provide more comprehensive direction that would result in the best management and protection of wild horse and burro territories with associated effects (DA-WHT-DC 1). The action alternatives would also include plan components to remove, improve, or reconstruct wildlife and range improvement infrastructure. These plan components may improve wild horse territories and animal distribution across designated territories (FW-WFP-0 2, FW-WFP-G 6, FW-GRZ-O 1).

Cumulative Environmental Consequences for Wild Horse Territories

There would be no cumulative environmental consequences under all alternatives because the wild horse territories would be maintained and protected under all alternatives.

Sangre de Cristo Pea Clam Zoological Area

A zoological area is a designated area that contains animal specimens, animal groups, or animal communities that are significant because of their occurrence, habitat, location, life history, ecology, rarity, or other features (FSM 2372.05 (4)). The Sangre de Cristo Pea Clam Zoological Area on the Questa Ranger District is the Carson's only zoological area (see plan appendix A, figure A-8).

The Sangre de Cristo pea clam is on the State's group 1 endangered list and only known to occur in the Middle Fork Lake on the Questa Ranger District. The lake, its shoreline, and immediate surrounding drainage are within the designated area as protected habitat for the pea clam.

Description of Affected Environment

Sangre de Cristo pea clam (*Pisidium sanguinichristi*) is a freshwater clam about the size of paper punch hole (up to 3.2 mm). It is endemic to the Middle Fork Lake, which is at 10,845 feet above sea level. Little is known about Sangre de Cristo pea clams. This species inhabits mud flats with emergent grasses at the edge on the lake. They filter feed possibly on small algae and other organic matter (NMDGF 2006b). There is no population information for Sangre de Cristo pea clam, and it has not been determined as a valid species at this time (Lang 2013). Threats to this species include water chemistry changes, emergent grass removal, and water quantity.

A water quality assessment conducted on Middle Fork Lake in 2007 by the New Mexico Environment Department (2007) found no chemical or physical exceedances of water quality criteria for Middle Fork Lake. An abundance of emergent vegetation is found along the shore of the lake as well as abundant green algae. Currently, this lake is only open to foot traffic and is within a closed allotment.

Environmental Consequences for the Sangre de Cristo Pea Clam Zoological Area

Methodology and Analysis Process

Effects from the alternatives to Sangre de Cristo Pea Clam Zoological Area will be evaluated by comparing the plan direction of each alternative toward the protection and management of Sangre de Cristo pea clams.

Analysis Assumptions

- Sangre de Cristo pea clam is a valid species
- All projects implemented within Sangre de Cristo Pea Clam Zoological Area will require a site-specific analysis of their potential impacts

Indicators

- Protection and management of Sangre de Cristo Pea Clam Zoological Area through plan direction

Environmental Consequences for the Sangre de Cristo Pea Clam Zoological Area Common to All Alternatives

Under all alternatives, protection of Sangre de Cristo pea clam habitat is included as a designated area with specific plan components (desired conditions, standards, or guidelines). Under all alternatives, the

combined management direction would maintain emergent grasses along the shore, maintain or improve water quality, and maintain water chemistry within Middle Fork Lake (DA-ZOO-DC 1-2 and DA-ZOO-S 1). Sangre de Cristo pea clam would continue to persist, and its habitat would continue to be protected under all alternatives.

Environmental Consequences for the Sangre de Cristo Pea Clam Zoological Area – Alternative 1

Alternative 1 would continue to protect and improve Sangre de Cristo pea clam habitat under Sangre de Cristo Pea Clam Zoological Area. This alternative would continue to maintain emergent grasses along the shore, maintain or improve water quality, and maintain water chemistry within Middle Fork Lake.

Environmental Consequences for the Sangre de Cristo Pea Clam Zoological Area Common to Alternatives 2, 3, 4, and 5

Sangre de Cristo Pea Clam Zoological Area is included in alternatives 2, 3, 4, and 5 as a designated area with specific plan components. Action alternatives include forestwide desired conditions and objectives for the Watershed and Water, Riparian Management Zones, Streams, Waterbodies, Springs and Seeps resource sections (FW-WSW-DC 1-3; FW-WSW-RMZ-DC 1-8; FW-WSW-RMZ-STM-DC 1-10; FW-WSW-RMZ-WB-DC 1-5; FW-WSW-RMZ-SNS-DC 1-7) that would improve altered hydrology by minimizing water diversions and improving hydrologic function, while maintaining systems that are resilient to climate change and associated disturbances such as fire across all aquatic systems including the Sangre de Cristo Pea Clam Zoological Area. Guideline (FW-WSW-G 1) would ensure that best management practices are applied to every site-specific project that has the potential to affect the watershed conditions across the forest. Sangre de Cristo Pea Clam Zoological Area direction, in combination with forestwide direction, would maintain or improve habitat for the Sangre de Cristo pea clam in this zoological area by preventing emergent grass removal, maintaining or improving water quality, and maintaining water chemistry.

Cumulative Environmental Consequences for the Sangre de Cristo Pea Clam Zoological Area

There would be no cumulative environmental consequences under all alternatives because the Sangre de Cristo Pea Clam Zoological Area would be maintained and protected under all alternatives.

Small-headed Goldenweed Botanical Area

A botanical area is a designated area that contains plant specimens, plant groups, or plant communities that are significant because of their form, color, occurrence, habitat, location, life history, arrangement, ecology, rarity, or other features (FSM 2372.05(3)). The Small-headed Goldenweed Botanical Area is the only botanical area designated on the Tres Piedras Ranger District of Carson (see plan appendix A, figure A-8).

Haplopappus microcephalus is a small-headed goldenweed but is now referred to as *Lorandersonia microcephala*. This plant is a Carson species of conservation concern and appears on the State endangered plant list. The massive granite outcrops along the Tusas Ridge of Tres Piedras are the only places in New Mexico where the plant has been located, thus adding to the ecological integrity of the area.

Description of Affected Environment

Small-headed goldenweed is found in granitic rock crevices within open ponderosa pine forests between 8,000 and 8,500 feet in elevation. It is locally abundant within its limited range between Tres Piedras and Petaca, New Mexico (NMRPTC 2020). The granite crevices in which this species is found offer

protection from human disturbance and stand-replacing wildfire. Threats include direct harm to the plant from recreational activities.

Rocky features in which this species thrives are inherently stable for long periods of time because they are changed primarily by geologic forces.

Environmental Consequences for Small-headed Goldenweed Botanical Area

Methodology and Analysis Process

Effects from the alternatives to Small-headed Goldenweed Botanical Area will be evaluated by comparing the plan direction of each alternative toward the protection and management of small-headed goldenweed.

Analysis Assumptions

- All projects implemented within Small-headed Goldenweed Botanical Area will require a site-specific analysis of their potential impacts to the area.

Indicators

- Protection and management of Small-headed Goldenweed Botanical Area through plan direction.

Environmental Consequences for Small-headed Goldenweed Botanical Area Common to All Alternatives

Under all alternatives, protection of small-headed goldenweed habitat is included as a designated area with specific plan components (desired conditions, standards, or guidelines). Under all alternatives, the combined management direction would reduce direct harm to the plant from recreational activities such as rock climbing (DA-BOT-G 1-2) and its habitat would continue to be protected (DA-BOT-DC-1 and 2). Small-headed goldenweed would continue to persist, and its habitat would continue to be protected under all alternatives.

Environmental Consequences for Small-headed Goldenweed – Alternative 1

Alternative 1 would continue to protect and improve small-headed goldenweed habitat under Small-headed Goldenweed Botanical Area. This alternative would continue to reduce direct harm from recreational activities and protect small-headed goldenweed habitat.

Environmental Consequences for Small-headed Goldenweed Common to Alternatives 2, 3, 4, and 5

Small-headed Goldenweed Botanical Area is included in the plan and other action alternatives as a designated area with specific plan components. Action alternatives include forestwide desired conditions for cliffs and rocky features (FW-VEG-DC 17-19; FW-VEG-PPF-DC 19; FW-VEG-PJO-DC 14; FW-VEG-PJS-DC 16; FW-SL-DC 7; FW-CRF-DC 1-3; DA-BOT-DC 1-2), which would promote ecological conditions to support small-headed goldenweed and its designated habitat. Also, desired conditions and guidelines for vegetation cliffs and rocky features, and wildlife, fish, and plants would protect non-vegetative habitat components from disturbance (FW-VEG-DC 13; FW-VEG-G 3; FW-CRF-G 1; FW-WFP-G 3). There are plan components forestwide and within Small-headed Goldenweed Botanical Area that specifically mitigate disturbance from recreational rock climbing and provide protections from trampling of plants (FW-VEG-S 1, FW-CRF-G 2, FW-CRF-G 4, FW-REC-G 1, FW-TFA-G 10, DA-BOT-G 1-2). Small-headed Goldenweed Botanical Area direction in combination with forestwide direction would maintain or improve habitat for small-headed goldenweed in this botanical area by mitigating disturbance from recreational activities.

Cumulative Environmental Consequences for Small-headed Goldenweed Botanical Area

There would be no cumulative environmental consequences under all alternatives because the Small-headed Goldenweed Botanical Area would be maintained and protected under all alternatives.

Socioeconomics

Description of Affected Environment

This section provides social and economic analysis, including past and current conditions and the potential consequences of the four alternatives on the social and economic environment. Section 219.8 of the 2012 Planning Rule requires that the plan provide for social, economic, and ecological sustainability, and further clarifies under section B that plan components must consider the following:

- social, cultural, and economic conditions relevant to the area influenced by the plan;
- scenic character and sustainable recreation, including recreation settings, opportunities, and access;
- multiple uses that contribute to local, regional, and national economies in a sustainable manner;
- ecosystem services;
- cultural and historic resources and uses; and
- opportunities to connect people with nature.

Management of public lands contributes to economies of surrounding communities. Job and income estimates are measures of the economic contribution from forest management of each alternative and are an informative indicator for understanding local economic impacts of different management alternatives. This section analyzes this economic impact. Only a portion of the full economic and social impact of forest management are captured here. The following analysis considers only the market transactions that result from activities on the Carson. Numerous other non-market social and economic values are associated with the national forest. The value of ecosystem services, such as, clean air and water, are not captured in the economic impact analysis. Therefore, this analysis should not be conflated with a representation of the total economic value of the forest.

Population Statistics

In 2010, New Mexico was home to more than 2 million people (less than 1 percent of the U.S. population) (US CB 2010). Since 1980, the state's population growth has increased faster than the rest of the United States. New Mexico's population grew by 16, 20, and 13 percent between 1980 and 1990, 1990 and 2000, and 2000 and 2010, respectively. The U.S. population grew at 10, 13, and 10 percent, during these same periods. Migration played a relatively minor role in New Mexico's population growth. Net in-migration to New Mexico was approximately 150,000 people between 1990 and 2000, and approximately 100,000 people between 2000 and 2010 (a reduction of roughly one-third). UNM Geospatial and Population Studies has projected state population growth rates for the next two decades of 14 and 11 percent, which will result in a population of more than 2.6 million by 2030 (US CB 2010). Figure 24 shows the percentage change in each of New Mexico's county populations between 2000 and 2010.

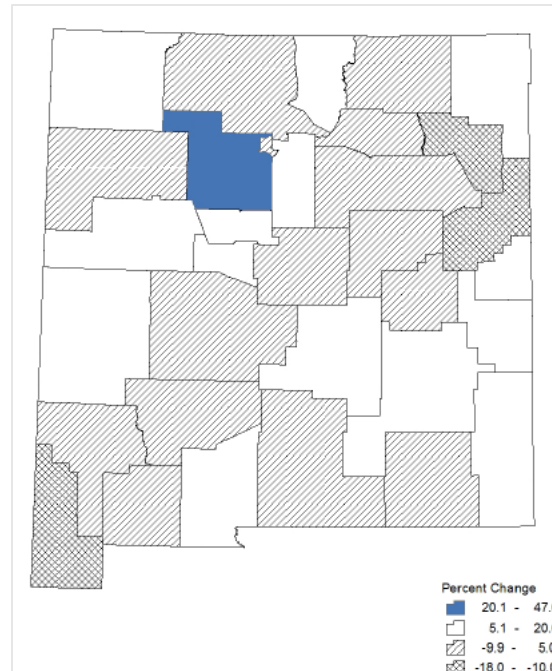


Figure 24. Percentage change in New Mexico county populations between 2000 and 2010

Source: U.S. Department of Commerce Census Bureau, 2000 and 2010 decennial censuses. Map created by UNM BEER.

Most New Mexico counties experienced population increases. Population declines that occurred across New Mexico during these years are in part a result of the Great Recession (October 2007 to June 2009) and the fact that New Mexico is largely a rural state without much to offer in the way of economic activity (UNM-BBER 2007, 2013). The Great Recession required many people to move to find work.

Compared with other states, New Mexico has a relatively small population. In 2010, New Mexico's population rank was 36; only 14 states had smaller populations. In addition to having a relatively small population, New Mexico's land area is relatively large and average population density is low. In 2010, New Mexico had a population density of only 17 people per square mile. Only four states have a lower population density Alaska, Montana, North Dakota, and Wyoming.

The assessment area contains approximately 4.4 percent of the population of the state of New Mexico. The assessment area has a population of 91,390, with Rio Arriba County being the most populous (40,218) and Mora County being the least (4,788). Figure 25 graphically depicts the population trend for the four counties, which has gradually increased from the 1970s to the early 2000s. From 1970 to 2013, population grew from 59,752 to 90,905 people, a 52 percent increase. Recent population trends for the assessment area show population at a plateau, with a slight decline beginning in the later 2000s.

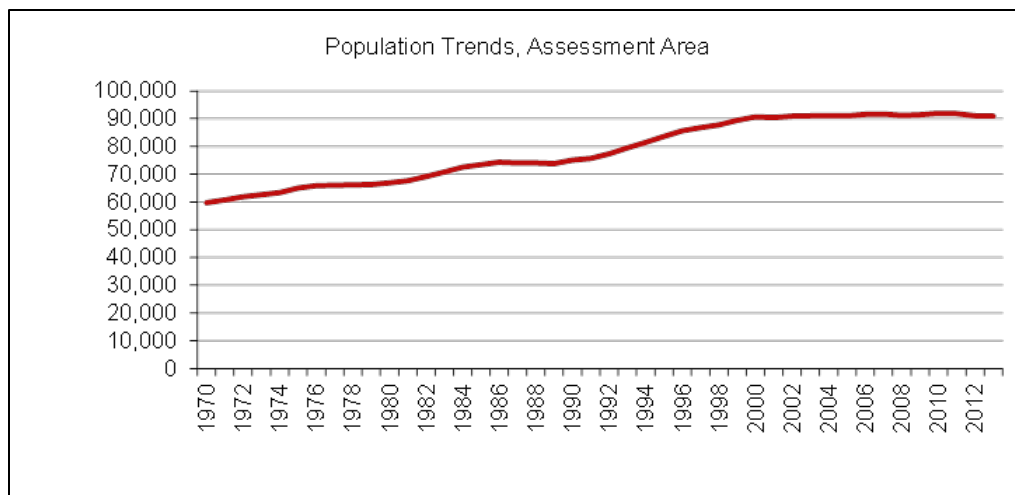


Figure 25. Cumulative population trend for the assessment area 1970-2012

Age and Gender Distribution

Changes in the age structure of New Mexico's population are similar to other areas of the country. The portion of the population in the 18 and under group steadily declined between 1990 and 2010 (from 25 to 21 percent), while the 65 and older age group steadily increased from 11 to 13 percent. These trends are expected to continue. The Bureau of Business and Economic Research report projects by 2030, those in the 0 to 14 age group will comprise 20 percent of New Mexico's population, and individuals age 65 and older will comprise 21 percent (UNM-BBER 2007, 2013). Between 1990 and 2010, the portion of New Mexico's population of working age (ages 15 to 64) grew from 64 to 66 percent but is expected to decline to 60 percent by 2030.

Population trends for the assessment area are similar to that of the state. In 2000, the age group of 18 and under made up 26 percent of the assessment area. Ages 45 to 64 made up the next biggest percentage at 25 percent. The 18 to 34 age group followed with 19 percent, and the 35 to 44 age group made up 15 percent. Those 65 and older age group made up the smallest percentage at 12 percent (table 73). Over a 13-year period (2000 to 2013), those 18 and under and persons 35 to 44 have seen decreases in their numbers, while persons 65 and older have seen increases. The 45 to 64 age group also experienced increases. The number of individuals ranging from 18 to 34 has remained fairly constant.

Table 73. Trend by age groups in the assessment area (2000–2013)

Age Group	2000 (population)	2013 (population)	2000 (percent)	2013 (percent)
Total population	90,538	91,390	NA	NA
Under 18	24,060	19,898	26.6%	21.8%
18–34	17,947	16,821	19.8%	18.4%
35–44	13,968	10,950	15.4%	12.0%
45–64	23,172	27,750	25.6%	30.4%
65 and older	11,391	15,971	12.6%	17.5%

The data in this table are calculated by the American Community Survey using annual surveys conducted during 2008-2013 and are representative of average characteristics during this period (US CB 2014).

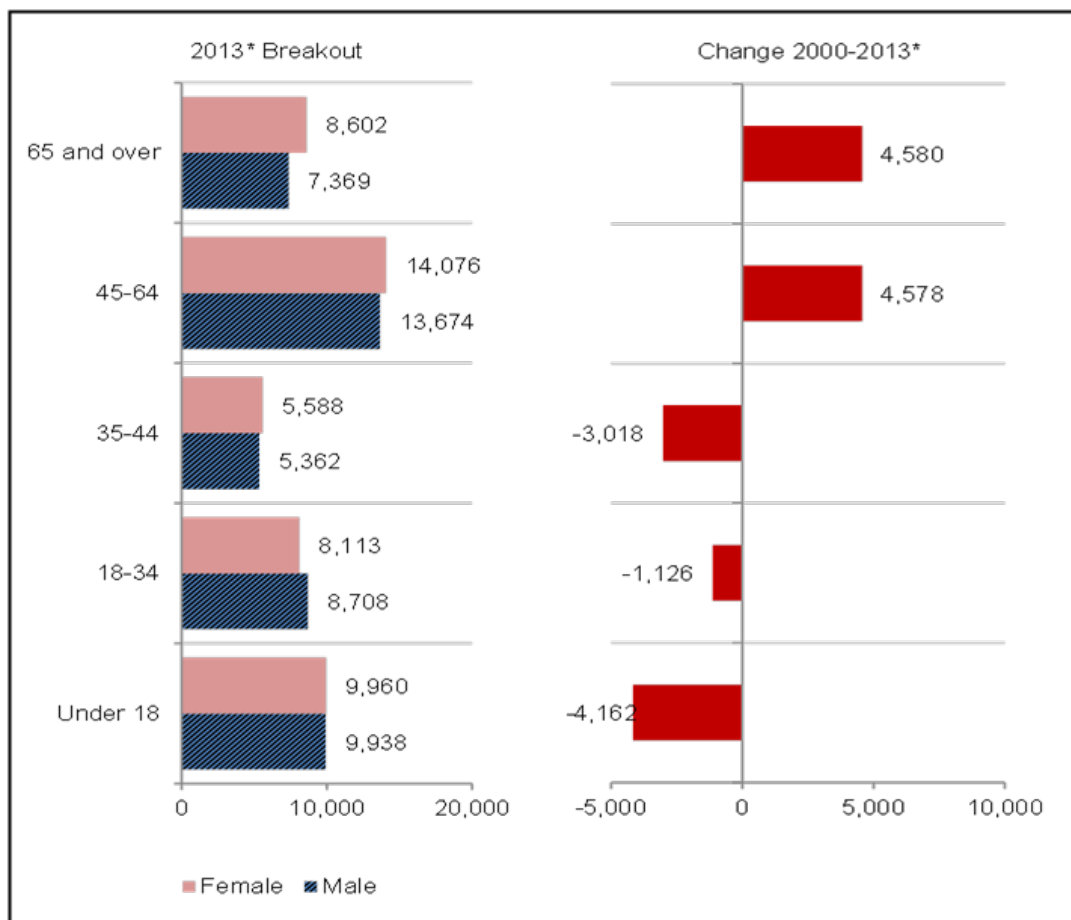


Figure 26. Change in population by age group between 2000 and 2013 within the assessment area

Figure 26 indicates the female and male ratio for each age group is relatively equal. It also shows the biggest gain occurred in the 45 to 64 and 65 and over age groups, and the largest decrease occurred in the 18 and under age group. The age structure of the area's population has been slowly aging since at least 1990.

Between 2010 and 2030, the portion of the population ages 18 and under is expected to continue declining, while the 65 and over age group is expected to increase more rapidly. At the same time, the population that is of working age (between ages 15 and 64) is expected to fall. By 2030, Taos County is projected to have a population that is one-third (33.1 percent) in the 65 and older age group. The portions of the assessment area and state populations projected to be in this older age category by 2030 are smaller, 29.6 and 21 percent, respectively.

Language

Over 93 percent of people living in the assessment area primarily speak English; however, nearly 50 percent speak a language in addition to English (table 74) (US CB 2014). Spanish is spoken by 43 percent of those who speak another language. Just under 6 percent speak a second language other than Spanish. Given that the assessment area's population is close to 10 percent Native American, one might assume that the other languages may also include Native American languages. When compared to the percentages across the state of New Mexico and the United States (table 74), the culturally rich and diverse population in the assessment area is evident by the percentage of people who speak a language in addition to English.

Table 74. Language spoken at home in the assessment area, New Mexico, and the United States

Language	Assessment Area (percent)	New Mexico (percent)	United States (percent)
Only English	50.7	63.9	79.3
In addition to English	49.3	36.1	20.7
Spanish or Spanish Creole	43.5	28.7	12.9
Other Indo-European	0.7	1.2	3.7
Asian & Pacific Island	0.4	0.9	3.3
Other languages	4.7	5.2	0.9
Speak English less than “very well”	6.5	9.6	8.6

The data in this table are calculated by the American Community Survey using annual surveys conducted during 2008–2013 and are representative of average characteristics during this period (US CB 2014).

Education

The state of New Mexico has historically struggled in educational performance. Year after year New Mexico ranks near the bottom, compared to the rest of the United States. The Education Research Center gave New Mexico a “D+” when it comes to a student's chance for success. The index measures the role of education in a person's life from cradle to career (Daniels 2014). For the four counties making up the assessment area, those with a high school degree or higher make up slightly over 83 percent of the population over 25 years of age (table 75). However, New Mexico does rank fourth in the nation for the number of people holding PhDs (Chokshi 2014).

New Mexico's population has become more educated during the last two decades. As detailed in Carnevale and others (2012), lingering effects of the Great Recession will likely continue to create an incentive for individuals to obtain higher education. It is expected that educational improvements will continue throughout Carson’s associated counties, and perhaps most notably in Taos County, which offers economic opportunities that are more likely to require higher education levels than the economic opportunities offered in more rural Mora and Colfax counties.

Table 75. Education attainment within the assessment area, New Mexico, and United States

Education	Assessment Area population	New Mexico population	United States population	Assessment Area (percent)	New Mexico (percent)	United States (percent)
Total population 25 years or older	64,296	1,347,229	206,587,852	NA	NA	NA
No high school degree	10,469	220,516	28,887,721	16.3	16.4	14.0
High school graduate	53,827	1,126,713	177,700,131	83.7	83.6	86.0
Associate degree	5,432	101,660	16,135,795	8.4	7.5	7.8
Bachelor's degree or higher	13,807	347,670	59,583,138	21.5	25.8	28.8
Bachelor's degree	8,349	198,521	37,286,246	13.0	14.7	18.0
Graduate or professional	5,458	149,149	22,296,892	8.5	11.1	10.8

The data in this table are calculated by the American Community Survey using annual surveys conducted during 2008–2013 and are representative of average characteristics during this period (US CB 2014). NA indicates not applicable.

Employment

Prior to this century, New Mexico's unemployment rate typically exceeded that of the United States as a whole. The relationship changed after 2002. Since 2006, the New Mexico unemployment rate has been considerably below that of the rest of the Nation. The gap between New Mexico and U.S. unemployment rates grew during the Great Recession, as the U.S. unemployment rate rose faster than New Mexico's. The gap between the two was greatest in 2009, when New Mexico had an unemployment rate of 6.8, while the U.S. unemployment rate was 9.3. In 2011, both the New Mexico and U.S. unemployment rates began to fall from their 2010 peaks. The U.S. rate fell more rapidly than the New Mexico rate, narrowing the gap between the two. As of 2011, the U.S. had an unemployment rate of 8.9, while New Mexico had a rate of 7.4. As the economy continues to recover from the Great Recession, unemployment rates are expected to continue declining.

Since 1990, the annual unemployment rate in the assessment area has ranged from a high of 16.1 percent in 1992 to a low of 4.4 percent in 2007 (figure 27). The Great Recession is also represented in figure 27 by the sharp increase in unemployment, beginning in 2008. Trends starting around 2011 show a decrease in the unemployment trend for the assessment area (NM DWS 2014).

Employment within the assessment area is primarily in the management and professional fields (34 percent); service and sales and office occupations (26 and 21 percent, respectively); and construction, extraction, maintenance and repair occupations (11 percent). Between 1970 and 2013, employment in the assessment area grew from 17,678 to 42,715 jobs, a 142 percent increase.

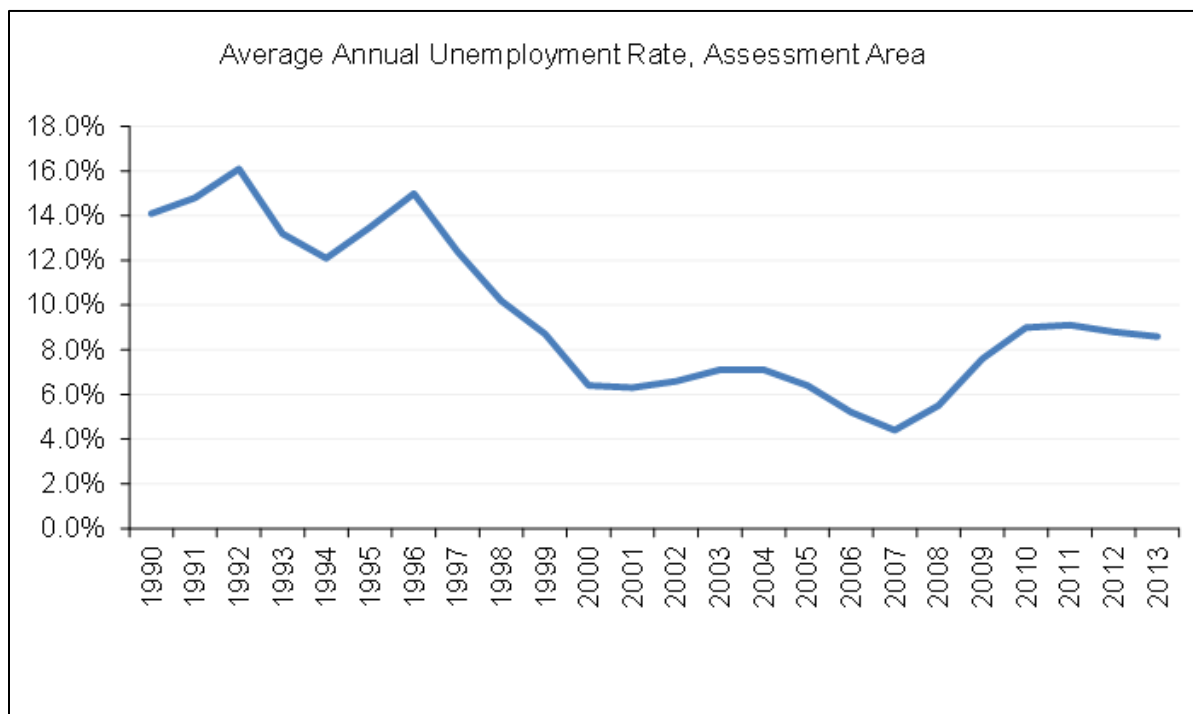


Figure 27. Average annual unemployment rate for the assessment area from 1990 to 2013

Source: New Mexico Department of Workforce Solutions (NM DWS 2014).

Income

New Mexico is considered to have a “lopsided” economy. While this economic condition is evident in all states to some degree, New Mexico is listed in the top 10 with the most income disparity. According to the [Economics Policy Institute \(Sommeiller and Price 2014\)](#), the top 1 percent average income is 15.6 times greater than the average income of the bottom 99 percent. New Mexico also has one of the

highest top-to-bottom ratios at 8.0. An average income of \$118,608 among the top 20 percent of families is 8 times the average income of \$14,798 in the bottom 20 percent (NM Legislative Council Service 2012).

In the assessment area, nearly half of the households earn less than \$35,000 (over 47.8 percent), while the top 1 percent earns \$200,000 or more (figure 28). Over 16 percent earn between \$50,000 and \$74,999.

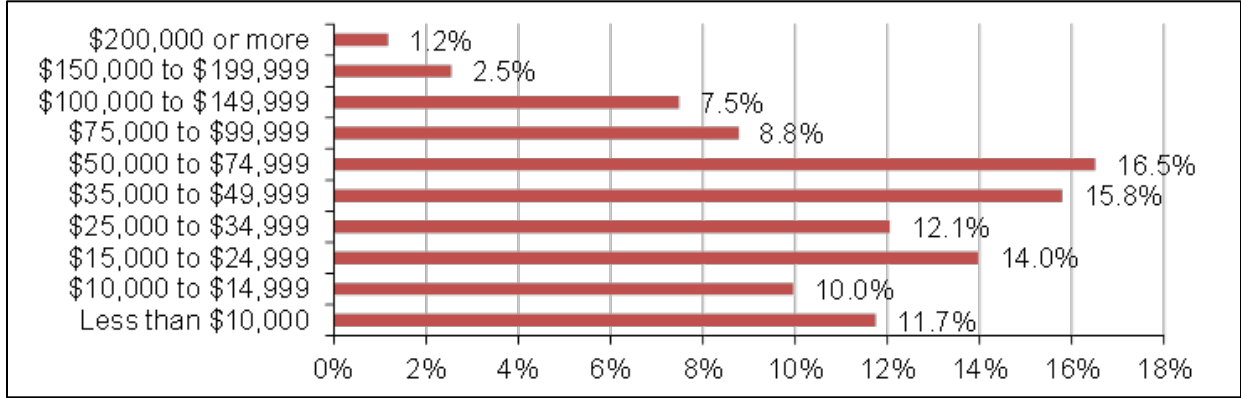


Figure 28. Household income distribution within the assessment area

The data in this table are calculated by the American Community Survey using annual surveys conducted during 2008-2013 and are representative of average characteristics during this period (US CB 2014).

Poverty is an important indicator of both economic and social well-being. Individuals with low incomes are more vulnerable to a number of hardships, which may negatively affect their health, cognitive development, emotional well-being, and school achievement. Following the Office of Management and Budget's directive 14, the Census Bureau uses a set of income thresholds that vary by family size and composition to determine who is poor. If the total income for a family or an individual falls below the relevant poverty threshold, then the household members are considered to be below the poverty level.

Both individual and family poverty rates are higher within the assessment area than they are in the state of New Mexico or the rest of the United States (figure 29). Trends in personal income are also plateauing with a slight decrease in 2012, after showing a strong growth trend from 1970 into the early 2000s (figure 30).

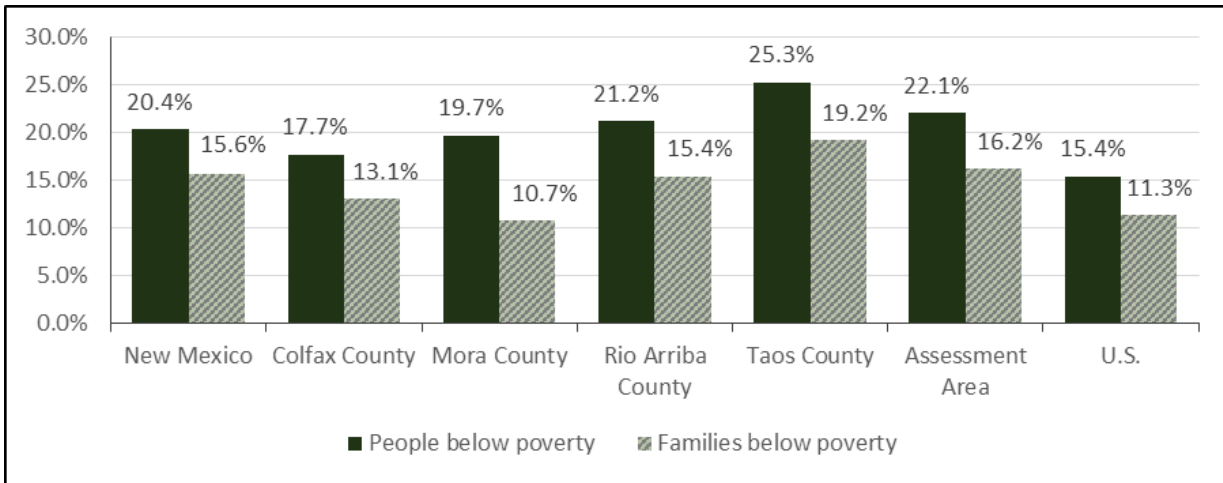


Figure 29. People and families below poverty level within the assessment area from 2008 to 2013

The data in this table are calculated by the American Community Survey using annual surveys conducted during 2008-2013 and are representative of average characteristics during this period (US CB 2014).

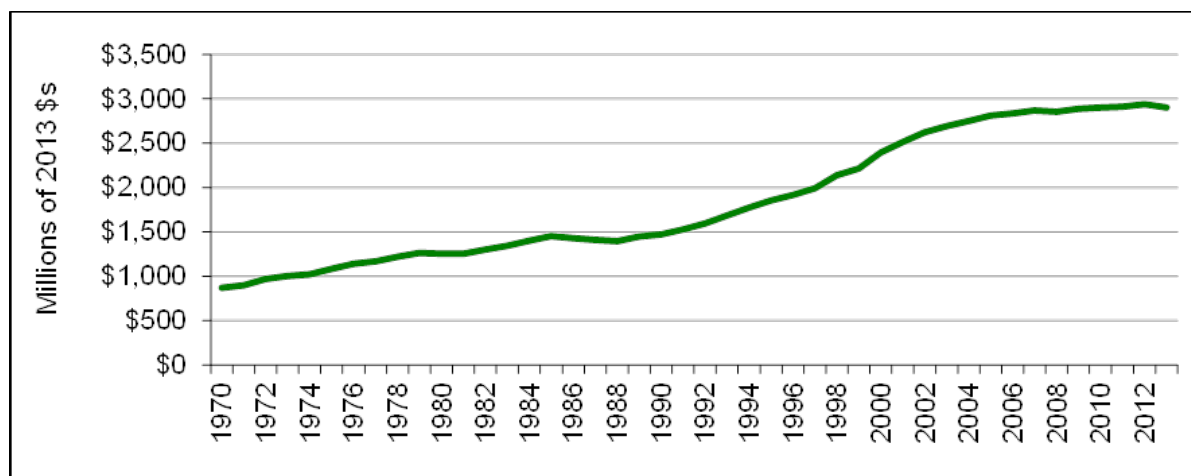


Figure 30. Total personal income trend for the assessment area from 2008-2013

The data in this table are calculated by the American Community Survey using annual surveys conducted during 2008-2013 and are representative of average characteristics during this period (US CB 2014).

Sectors of the Economy

Considering the assessment area is generally made up of small and often rural communities, there are a wide range of industries represented. The majority of industries tend to be in the services sector versus the non-services sectors. The four largest sectors of the economy in the assessment area are (table 76):

- Government (21.4 percent)
- Accommodation and food services (10.6 percent)
- Retail (10 percent)
- Health care and social assistance (10 percent)

Table 76 and figure 31 display how the industry sectors made up of services, non-services, and government have trended from 2001 to 2013. The service industry has experienced a 2 percent increase from 25,176 to 25,583 jobs. Non-services dropped from 8,345 to 7,538 jobs, a 10 percent loss, and government fell from 9,273 to 9,132 jobs, a 2 percent decrease.

Table 76. Employment by industry in the assessment area

Industry Sector	2001	2013	Change 2001-13	2001 (percent)	2013 (percent)	Percent change 2001-13
Total number of jobs	42,697	42,715	18	NA	NA	NA
Non-services related	8,345	7,538	-807	19.5	17.6	-9.7
Farm	2,878	3,259	381	6.7	7.6	13.2
Forestry, fishing, and related activities	404	305	-99	0.9	0.7	-24.5
Mining (including fossil fuels)	701	710	9	1.6	1.7	1.3
Construction	3,069	2,430	-639	7.2	5.7	-20.8
Manufacturing	1,293	834	-459	3.0	2.0	-35.5
Services related	25,176	25,583	407	59	59.9	1.6
Utilities	291	316	25	0.7	0.7	8.6
Wholesale trade	475	441	-34	1.1	1.0	-7.2
Retail Trade	4,969	4,268	-701	11.6	10.0	-14.1

Industry Sector	2001	2013	Change 2001–13	2001 (percent)	2013 (percent)	Percent change 2001–13
Transportation and warehousing	724	522	-202	1.7	1.2	-27.9
Information	454	431	-23	1.1	1.0	-5.1
Finance & insurance	939	1,073	134	2.2	2.5	14.3
Real estate & rental & leasing	1,407	1,648	241	3.3	3.9	17.1
Professional and technical services	1,398	1,609	211	3.3	3.8	15.1
Management of companies and enterprises	51	24	-27	0.1	0.1	-52.9
Administrative and waste services	1,395	1,353	-42	3.3	3.2	-3.0
Educational services	332	516	184	0.8	1.2	55.4
Health care & social assistance	4,008	4,329	321	9.4	10.0	8.0
Arts, entertainment, and recreation	1,714	1,959	245	4.0	4.6	14.3
Accommodation & food services	4,453	4,532	79	10.4	10.6	1.8
Other services, except public administration	2,566	2,562	-4	6.0	6.0	-0.2
Government	9,273	9,132	-141	21.7	21.4	-1.5

NA indicates not applicable.

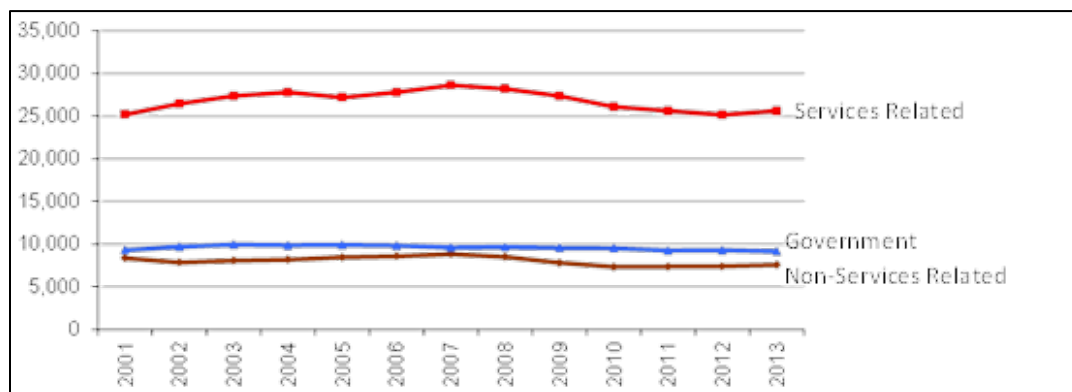


Figure 31. Employment by industry category trend in assessment area from 2001 to 2013

Housing

Housing statistics for the assessment area show close to 33 percent of current housing is vacant (table 77). A large portion of vacant homes are seasonal, recreational use, or occasionally used homes. For over 38 percent of households within the assessment area, housing costs account for more than 30 percent of household income (table 78).

According to a research study conducted for the [Bipartisan Policy Center \(Pendall et al. 2012\)](#), Hispanic Americans saw a substantial increase in home ownership from 1993 to 2005. During the housing crisis from 2007 to 2012, not only were those gains lost, but home ownership for Hispanics now lags 25 percent behind non-Hispanics. As a result of this set-back, the median wealth of Hispanic people has fallen by 50 to 65 percent. During 2005 to 2009, Hispanics saw their median wealth drop by 66 percent, when compared to 16 percent in the white population. This is significant to the assessment area, because well over one-third of the population is made up of Hispanic people (table 85), as is over half of the county population in Rio Arriba and Taos Counties and nearly 80 percent in Mora County.

Table 77. Housing characteristics for the assessment area (US CB 2014)

Housing Characteristic	Assessment area (number)	Assessment area (percent)
Total housing units	52,854	Not applicable
Occupied	35,227	66.6
Vacant	17,627	33.4
For rent	1,456	2.8
Rented, not occupied	91	0.2
For sale only	825	1.6
Sold, not occupied	308	0.6
For seasonal, recreational, occasional use	10,353	19.6
For migrant workers	140	0.3
Other vacant	4,427	8.4

Table 78. Housing costs as percent of household in assessment area compared to U.S. (US CB 2014)

Housing Characteristic	Assessment Area (%)	New Mexico (%)
Monthly cost <15% of household income	22.9	22.3
Monthly cost >30% of household income	38.4	33.7
Gross rent <15% of household income	13.5	12.4
Gross rent >30% of household income	42.5	44.9

Environmental Consequences for Socioeconomics

Methodology and Analysis

An economic contribution analysis estimates the role of Forest Service resources, uses, and management activities on employment and income in the communities that surround the Carson. The Carson extends into four New Mexico counties—Mora, Rio Arriba, Colfax, and Taos. In addition, San Juan County, New Mexico, and Costilla and Conejos Counties in Colorado are included in the study area due to their social and economic linkages between residents and the Carson (USDA FS Carson NF 2015a). These seven counties make up the regional economy for the purposes of this economic impact analysis.

Economic contribution to local counties of the Carson was estimated with input-output analysis using the IMPLAN (IMpact analysis for PLANning) modeling system (IMPLAN 2016). The modeling system allows the user to build regional economic models of one or more counties for a particular year and estimates the economic consequences of activities, projects, and policies on a region. IMPLAN uses Forest Service data on expenditures and resource uses to estimate the economic consequences of Forest Service management.

Input-output analysis represents linkages between sectors in an economy. IMPLAN not only examines the direct contributions from the Carson but also indirect and induced effects. Indirect employment and labor income effects occur when a sector purchases supplies and services from other industries to produce their product. Induced effects are the employment and labor income generated because of spending new household income generated by direct and indirect employment. For example, visitors to Carson spend money on accommodation and food. Accommodation and food service businesses buy supplies from other businesses. The employees of these firms spend their earnings on a variety of goods and services. These transactions result in direct, indirect, and induced effects, respectively, in the regional economy. Direct, indirect, and induced effects are combined in the discussion of effects.

Potential economic impacts are assessed using the Forest Economic Analysis Spreadsheet Tool (FEAST) developed by the U.S. Forest Service Inventory and Monitoring Institute in Fort Collins, Colorado. This tool uses a Microsoft Excel workbook as an interface between user inputs and data generated using the IMPLAN input-output modeling system.

The FEAST analysis assesses the economic impacts of the resource outputs projected under each alternative. Resource outputs in this context are the amount of a resource (forest products, animal unit months, recreation visits, etc.) that would be available for use under each alternative. Quantitative inputs (e.g., animal unit months, recreation visits, and Department of Interior payments to counties) were obtained from Carson program areas for this analysis. The model for this analysis used the 2016 IMPLAN data, which is the latest available dataset.

Data Sources and Assumptions

Data on use levels under each alternative were collected from the Carson. In most instances, the precise effect of an alternative is unknown. Therefore, the differences are based on the professional expertise of resource specialists. The purpose of the economic analysis is to compare the relative impacts of the alternatives.

Recreation

This analysis used the most recent National Visitor Use Monitoring program estimates available, which were from 2013. Of 740,000 total recreational visits to the Carson, 62 percent originated outside of the local area (USDA FS 2013a). The distribution of visitor type (i.e., local or non-local visitor) and use type (e.g., was the visit wildlife-related?) are used to estimate visitor spending. Average visitor expenditures by type were obtained from the Forest Service's National Visitor Use Monitoring Program (USDA FS 2013a).

The estimated recreation-related impacts capture only the expenditures of non-local visitors (that is, those who traveled more than 50 miles to the Carson). This is because non-local visitors bring “new money” to communities near the Carson. If recreational opportunities were no longer available on the Carson, non-local visitors would not be expected to spend money in the counties that surround the forest. They may travel to another area or spend money in their home county. In contrast, most local visitors would continue to spend money on another activity in the local area if recreational opportunities were no longer available on the Carson.

Timber

Table 79 provides the estimated annual forest product volumes available, by alternative. These volumes are shown in hundreds of cubic feet (CCF) per year and are used to estimate the economic impact of timber-related activities on the Carson. Softwood sawtimber harvest is based on modeling of timber treatment objectives under each alternative (see appendix C and D). Fuelwood under alternative 1 is the recent average of permitted volumes. The fuelwood volume for alternative 1 of 15,506 CCF per year is partially modeled as green fuelwood removal (6,810.5 CCF per year), while the remainder is removal by dead and down permit (8,695.5 CCF per year), which is held constant across alternatives. Pole and post volumes under alternative 1 are equal to the recent averages of permitted volumes. For each action alternative, post and pole volumes were calculated based on the total non-commercial product volume in that alternative. If total non-commercial product volume was more in the action alternative than in alternative 1, estimated post and pole volumes were increased proportionally. If the action alternative produced less total non-commercial volume, the estimated volume of posts and poles was decreased by the same percentage. For example, there is a 40 percent increase in all non-commercial products (including dead and down fuelwood) in alternative 2 compared to alternative 1, and thus poles increase from 561 to 785 CCF per year (+140 percent).

Alternative 3 would provide the highest annual forest product volumes. The variation in forest products drives most of the variation in economic consequences across alternatives. This table will be referenced in the alternative-specific descriptions of the economic consequences for forest product removal that follow.

Table 79. Estimated annual forest product volume by alternative

Forest Product	Alternative 1 (CCF*/year)	Alternative 2 (CCF/year)	Alternative 3 (CCF/year)	Alternative 4 (CCF/year)	Alternative 5 (CCF/year)
Harvest-softwood sawtimber	3,756	34,942	70,139	4,002	34,942
Poles	561	785	1290	437	785
Posts	3	4	6	2	4
Fuelwood	15,506	22,028	30,788	12,103	22,028
Total	19,826	57,759	102,224	16,545	57,759

* CCF is hundreds of cubic feet

Grazing

The economic impact of grazing in alternative 1, which would continue current management, was estimated using an average of permitted use from 2011 to 2013 when the Carson was experiencing drought. Changes across alternatives are estimated as changes from this baseline. Actual use is permitted annually based on a number of factors, such as current forage and market conditions. For comparison, the analysis assumes that current market demand for livestock would continue throughout the next several decades with a continued, consistent demand for grazing on forest lands. While new plan direction is designed to improve vegetation conditions, periods of drought are also expected to occur more frequently in the future.

Payments to States and Counties

The Federal Government makes payments to states and counties that contain NFS lands. These payments fall into two categories: payments in lieu of taxes and Secure Rural Schools and Community Self-Determination Act payments.

Federal agencies do not pay property taxes; therefore, payments in lieu of taxes are distributed to counties to compensate for the local services, such as law enforcement, road maintenance, and fire departments that support activities on Federal lands. Table 80 lists the payments in lieu of taxes made on behalf of the Carson for fiscal year 2017. Although similar year to year, an average of the payments in fiscal years 2015 through 2017 was used for this analysis.

Secure Rural Schools and Community Self-Determination Act payments are based on Forest Service receipts (from grazing, timber, and recreation, for example). Secure Rural Schools and Community Self-Determination Act payments are intended to improve public schools, maintain infrastructure, improve the health of watersheds and ecosystems, protect communities, and strengthen local economies. Table 80 lists the Secure Rural Schools and Community Self-Determination Act payments by county for the Carson for fiscal year 2017. Although similar year to year, an average of the payments in 2014, 2015, and 2017 was used for this analysis. Congress did not authorize the Secure Rural Schools and Community Self-Determination Act and no payments were made in 2016.

Table 80. Payments to counties for the Carson in fiscal year 2017

County	Secure Rural Schools and Community Self-Determination Act Payments	Payments in Lieu of Taxes	Total Forest Service-related Payments
Colfax County	\$67,790	\$166,163	\$233,953
Mora County	\$12,906	\$246,783	\$259,689
Rio Arriba County	\$1,009,505	\$2,277,385	\$3,286,890
Taos County	\$513,161	\$1,733,264	\$2,246,425
Total	\$1,603,362	\$4,423,595	\$6,026,957

Source: USDA FS (2018b); USDI (2018)

Economic Impact Analysis

Table 81 provides employment estimates by resource and alternative. Recreation and minerals account for about half of Carson-related employment under all alternatives. Timber would contribute the most jobs under alternative 3, while in all other action alternatives recreation makes the greatest contribution to the local economy in terms of estimated jobs. Alternative 3 provides the largest impact to the local economy in terms of jobs, due to a significant increase in forest product volumes available.

Table 81. Employment (number of jobs) by program area and alternative

Program Area	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Non-wildlife and fish-related recreation	419	422	422	422	422
Wildlife and fish-related recreation	28	29	29	29	29
Grazing	247	253-260	256-260	213-218	251-256
Timber	31	244	486	31	244
Minerals	330	330	330	330	330
Payments to states/counties	176	176	176	176	176
Forest Service expenditures	278	278	278	278	278
Total forest management	1,508	1,731 to 1,738	1,976 to 1,980	1,478 to 1,483	1,728 to 1,733
Percent change from current	not applicable	14.8% to 15.3%	31.1% to 31.4%	-1.9% to -1.6%	14.7% to 15.0%

Source: USDA FS Carson NF (2018a)

Under all alternatives, employment supported by activities on the Carson would account for approximately 1.3 to 1.8 percent of total employment in the study area.

The sectors with the most Carson-related employment are government, agriculture, mining, retail trade, and accommodation and food services. These sectors are, in part, associated with timber, mining, and tourism economies, which are supported by the Carson and other public and private lands in the study area.

Table 82 provides labor income estimates by resource area and alternative. As with the employment estimates, minerals, Forest Service expenditures, and recreation are the three largest program contributions to local economic activity, except in alternative 3 where the timber program would make the greatest contribution of labor income to the study area economy. Alternative 3 provides the largest overall impact to the local economy in terms of labor income, due to a significant increase in forest product volumes available.

Together, the labor income and job contribution projections illustrate differences in income per job by program area. For instance, while each grazing-related job provides approximately \$18,000 in labor income per job, timber-related jobs provide \$44,000, and each minerals-related job provides over \$65,000. This comparison reveals that jobs supported by the minerals program pay well compared to jobs supported by grazing activities on the Carson. Factors that contribute to the differences in labor income include whether the job is seasonal or part-time and the required education or skill level.

The sectors with the most Carson-related labor income are mining; government; accommodation and food services; retail trade; and agriculture. These sectors are, in part, associated with timber, mining and tourism economies.

Table 82. Labor income contributed (1,000s of 2016 dollars) by resource area and alternative

Resource	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Non-wildlife and fish-related Recreation	\$10,765	\$10,855	\$10,855	\$10,855	\$10,855
Wildlife and Fish-related Recreation	\$836	\$861- \$878	\$861- \$878	\$853- \$870	\$853- \$870
Grazing	\$4,365	\$4,490–\$4,615	\$4,532–\$4,615	\$4,218–\$4,302	\$4,448–\$4,532
Timber	\$1,359	\$10,917	\$21,802	\$1,385	\$10,917
Minerals	\$21,520	\$21,520	\$21,520	\$21,520	\$21,520
Payments to States/Counties	\$5,214	\$5,214	\$5,214	\$5,214	\$5,214
Forest Service Expenditures	\$13,154	\$13,154	\$13,154	\$13,154	\$13,154
Total Forest Management	\$59,334	\$69,132–\$69,274	\$80,059–\$80,159	\$59,320–\$59,420	\$69,082–\$69,182
Percent Change from Current	not applicable	16.5%–16.8%	34.9%–35.1%	0.0%–0.1%	16.4%–16.6%

Source: USDA FS Carson NF (2018a)

Environmental Consequences for Socioeconomics Common to All Alternatives

Climate: Changes in climate may have a major effect on ecosystems' capacity to provide ecosystem services (Inkley et al. 2004). As the human population continues to grow in the 21st century, so too will its demand for the goods and services that ecosystems provide. Ecosystem services brought by wildlife (e.g., pollination, natural pest control, seed dispersal, nutrient cycling) are derived from their roles within systems. If an ecosystem is vulnerable to changes in climate, so are the services it provides. Not only do animal and plant species contribute to ecosystem stability or to ecosystem health and productivity, but wildlife species provide a recreational value (e.g., sport hunting, wildlife viewing), which is large in market and non-market terms. In addition, a reduction in species, due to the loss or significant alteration of their habitat, could impact the cultural and religious practices of indigenous peoples around the world. Changes in the structure and function of affected ecosystems can result in a loss of species that can lead to loss of aesthetics and revenue (IPCC 2007b). Vegetation protects soil against erosion and forest dieback or uncharacteristic wildfires can greatly increase watershed sediment yield (Allen and Breshears 1998; J. D. Miller et al. 2003), potentially reducing water storage capacity in reservoirs.

Minerals: Natural gas and oil, as well as stone, sand and gravel, and clay are removed from the Carson. The quantities removed are not expected to differ among alternatives because there are no plan components that limit removal were it currently does or is likely in the future to occur. However, oil and gas production and associated revenues fluctuate based on global market conditions and are outside the control of forest management. Based on 2016 revenues, mineral activities on the Carson would support

approximately 330 jobs and \$21.5 million in labor income, annually. Mineral products would be available under all alternatives for traditional and other local uses including ceremonial, building, or craft uses.

Payments to States and Counties: As noted above, payments to local governments are made on behalf of the Carson through payments in lieu of taxes and the Secure Rural Schools and Community Self-Determination Act program. Secure Rural Schools and Community Self-Determination Act payments are a function of forest revenues and forest revenues would be affected by different management alternatives, specifically, the variation in forest product removal across alternatives (table 80). However, payments in lieu of taxes are adjusted based on revenue-sharing payments such as Secure Rural Schools and Community Self-Determination Act and are intended to reduce the year-to-year volatility of payments to local governments (Headwater Economics 2019). Because these funding levels are subject to future congressional adjustments and dependent on Federal appropriations, this analysis assumes no variation in their estimation. These payments would support approximately 176 jobs and \$7.3 million in labor income annually under all alternatives. Under all alternatives, these programs would support local services, such as law enforcement, road maintenance, schools and fire protection and improve quality of life for local residents.

Forest Service Expenditures: Across all alternatives, Carson salary and non-salary (e.g., field and office equipment and supplies) expenditures support approximately 278 jobs and \$13.2 million in labor income in the local economy, annually. Forest budgets may fluctuate over the life of the plan but are not dictated by the plan or alternatives. Forest budgets are distributed by an act of Congress and therefore no variation is modeled. These expenditures support local businesses directly and pay employees who in turn spend money locally.

Environmental Consequences for Socioeconomics Common to All Action Alternatives

Recreation: General recreation-related visitation is expected to increase slightly relative to alternative 1 under all action alternatives (alternatives 2, 3, 4, and 5). While downhill skiing visits are likely to increase over the life of the plan, they are as likely to do so under the current plan as they would be under the action alternatives. Therefore, no attempt was made to model increased impacts. The action alternatives have direction to improve the opportunities and experiences that recreational trails provide. They also emphasize collaboration and partnering to develop and maintain trails. The potential exists to build a better trail system that better meets user needs and attracts more visitors to the area. Improving the conditions of roads and trails would improve user satisfaction and ease of access and may contribute to increased visitation.

Fishing opportunities would improve as a result of desired conditions to improve stream quality and riparian health. Increased riparian vegetation in some riparian areas would make access to some streams more difficult, but not for all riparian types. Improvements made in the riparian zone would also improve habitat conditions for other wildlife, and increased forest and grassland restoration should improve forage production and improve habitat for wildlife. Together these may increase visits for wildlife viewing and improve quality of hunting, however the amount of hunting that can occur on the forest is regulated by New Mexico Game and Fish. Hunting is therefore not estimated to vary under any alternative. Plan direction that increases potential visitation would benefit the economy of surrounding communities with jobs and income due to visitor expenditures, including lodging, meals, and other expenditures.

Range: There is a slight increase in the economic impact of the grazing program under all action alternatives. Increased levels of forest and grassland restoration would increase herbaceous understory growth, resulting in increased forage availability. Plan components would increase opportunities to graze livestock, benefitting area ranchers, ranching-related industries, and sustaining traditional uses of the forest.

Traditional Communities: All action alternatives have sections that focus on traditional communities and uses. There would be a greater recognition and support of traditional uses for cultural and subsistence needs including, use of common waters, use of common pasture for grazing livestock, wood gathering, collection of soils and rocks, gathering of plants and plant materials, hunting and fishing, and other religious, ceremonial, and recreational uses. The uniqueness, values, and history of tribal cultures and rural historic communities would be better recognized and appreciated. Better coordination with these communities would provide opportunities for youth education and sustaining heritage, language, culture, traditions, and the environment.

Partnerships: All action alternatives have direction regarding collaborative partnerships. A network of partners and volunteers would provide additional capacity to effectively and efficiently manage forest resources, communicate with and educate the public, and achieve short- and long-term mutually shared goals. Open communication with partners about expectations and partnering opportunities would encourage growth in existing relationships and promote new partnerships. An open exchange of information would promote collaborative development of forest priorities, a connection to place and its history, and a sense of stewardship. Partnerships across ownership boundaries would improve landscape-scale management and better address ecological and societal issues.

Environmental Consequences for Socioeconomics – Alternative 1

Alternative 1 would continue Carson management according to the 1986 Forest Plan. Management actions under alternative 1 are expected to support 1,507 jobs and approximately \$59.3 million in labor income in the local economy. The contribution to the local economy by alternative 1 in terms of jobs is second lowest after alternative 4. Its contribution of labor income is also low, similar to alternative 4.

Recreation: The 2013 level of 740,000 annual recreation visits to the Carson would continue, with most of these visits originating outside of the local area. The expenditures of non-local visitors on the Carson would support approximately 446 jobs and \$11.6 million in labor income, annually.

Range: Actual use varies based on local forage and market conditions. Authorized use averaged 83,167 animal unit months (80,293 for cattle and horses and 2,874 for sheep and goats) between 2011 and 2013 when the forest was experiencing drought. Drought conditions lasted from the mid 1990's to 2012 which caused authorized animal unit months to decrease. Until 2018 conditions were wetter and overall range conditions improved; however, periods of drought are also expected to continue into the future. Current utilization supports 247 jobs and \$4.4 million in labor income and would be expected to remain steady into the future.

Timber: Forest product removal would continue at the recent average rate of 19,826 CCF per year (table 79). Forest product removal under alternative 1 would support 31 jobs and \$1.4 million in labor income in the local economy, annually.

Environmental Consequences for Socioeconomics - Alternative 2

Management actions under alternative 2 are expected to support approximately 1,734 jobs and \$69.2 million in labor income in the local economy. The contribution to the local economy by alternative 2 in terms of jobs and labor income would be similar to alternative 5 and second highest behind alternative 3.

Recreation: Carson visitation is estimated to increase slightly under alternative 2, compared to alternative 1. Restoration and improvement of wildlife habitat would encourage additional wildlife-related recreational visits. Alternative 2 would support approximately 451 jobs and \$11.7 million in labor income in the local economy, annually, more than alternative 1 and similar to the other action alternatives.

Range: Alternative 2 increases the rate of vegetation restoration that should open up forested lands and increase available forage. This in turn is expected to increase opportunities to graze livestock and reduce competition with other ungulates. Sheep animal unit months have been constant over time both in drought years and wet years, so no change is expected. The grassland maintenance management area would support additional grazing opportunities. While, there are differences in management, and resulting forage production, the estimated economic impacts are only minimally different from action alternatives 3 and 5. Alternative 2 would support approximately 257 jobs and \$4.6 million in labor income in the local economy, annually.

Timber: Alternative 2 would significantly increase the removal of timber and other wood products compared to alternative 1 and would therefore increase local employment and labor income related to timber activities. Alternative 2 has the potential to provide increased commercial timber volumes because it would increase mechanical treatment for forest restoration. Based on the estimated annual forest product volumes listed in table 79, forest product removal under alternative 2 would support 244 jobs and \$10.9 million in labor income in the local economy, annually. Increased employment and labor income generated from timber and other forest product removal may support future opportunities for the growth or development of local or regional timber and other forest products industries in the surrounding region.

Environmental Consequences for Socioeconomics - Alternative 3

Management actions under alternative 3 are expected to support approximately 1,978 jobs and \$80.1 million in labor income in the local economy. This alternative would create the greatest estimated economic impact in terms of jobs and labor income.

Recreation: Carson visitation is estimated to increase slightly under alternative 3 compared to alternative 1, but only minimally relative to alternative 2. The number of motorized recreation and bicycling visitors may increase under alternative 3 due to the lack of management area restrictions which would limit these opportunities and a focus on new trail construction. However, there may be offsetting impacts to habitat that could reduce wildlife related visits. Alternative 3 would support approximately 451 jobs and \$11.7 million in labor income in the local economy, annually, similar to the other action alternatives.

Range: Alternative 3 thins overstocked forests faster than any other alternative, which should increase available forage. Sheep animal unit months have been constant over time both in drought years and wet years, so no change from alternative 1 is expected. While there are differences in management and resulting available forage across all action alternatives, the estimated economic impacts are only minimally different from alternatives 2 and 5. Alternative 3 would support approximately 258 jobs and \$4.6 million in labor income in the local economy, annually.

Timber: Alternative 3 would remove the greatest annual volume of timber and other wood products and would therefore result in the highest local employment and labor income related to timber activities. Alternative 3 has the potential to provide the most commercial timber volume because it would mechanically treat the most acres. In addition, alternative 3 has the most opportunity for harvesting posts, poles, and fuelwood. It would recommend no wilderness and includes fewer management areas that restrict access or mechanical means to cut fuelwood and other forest products. It encourages more roads that would increase access to wood products. Based on the estimated annual forest product volumes listed in table 79, forest product removal under alternative 3 would support 486 jobs and \$21.8 million in labor income in the local economy, more than any other alternative. Increased employment and labor income generated from timber and other forest product removal would be most likely to support future opportunities for the growth or development of local or regional timber and other forest products industries in the surrounding region.

Environmental Consequences for Socioeconomics – Alternative 4

Management actions under alternative 4 are expected to support approximately 1,480 jobs and \$59.4 million in labor income in the local economy. This alternative would provide the fewest estimated jobs but would be similar to alternative 1 in terms of its impacts on the local economy.

Recreation: Carson visitation is estimated to increase slightly under alternative 4 relative to alternative 1. Wildlife habitat would be improved, but not as much as under alternative 2. Access for hunting, fishing, motorized, and mechanized activities would be more restricted by recommended wilderness and other management areas. There would be more areas with additional protections that would provide primitive recreation experiences. Alternative 4 would support approximately 451 jobs and \$11.7 million in labor income in the local economy, annually, similar to the other action alternatives.

Range: Alternative 4 has slightly fewer estimated animal unit months than other action alternatives, but more than alternative 1. While additional fire should open up tree canopies on more lands and increase available forage relative to alternative 1, fires may be more uncharacteristic relative to other action alternatives with more potential for negative impacts on range conditions. Alternative 4 does not have the Grassland Maintenance Management Area and it has the second most recommended wilderness, which limits the ability to manage range conditions in those areas. Therefore, this action alternative would have the least potential for improving forage through management. Alternative 4 has a standard that sheep allotments cannot overlap bighorn sheep habitat, which could potentially result in a reduction—modeled as an elimination—of permitted sheep. Alternative 4 would support approximately 216 jobs and \$4.3 million in labor income in the local economy, annually.

Timber: Alternative 4 would have the lowest overall timber and other wood product removal although saw timber volumes are slightly higher than alternative 1. It would recommend additional wilderness areas and includes management areas that restrict access or mechanical means to cut fuelwood and other forest products. It encourages road decommissioning and discourages new road construction, which could limit access to wood products. The resulting economic impact is not meaningfully different from alternative 1. Based on the forest product removal estimates listed in table 79, alternative 4 would support 31 jobs and \$1.4 million in labor income in the local economy, annually.

Environmental Consequences for Socio-Economics—Alternative 5

Management actions under alternative 5 are expected to support approximately 1,731 jobs and \$69.1 million in labor income in the local economy. The contribution to the local economy by alternative 5 in terms of jobs and labor income would be similar to alternative 2.

Recreation: Alternative 5 would restrict restoration and access for motorized and mechanized recreation in additional recommended wilderness areas. There would be additional opportunities for primitive recreation experiences. Alternative 5 would also support approximately 451 jobs and \$11.7 million in labor income in the local economy, annually, similar to the other action alternatives.

Range: Alternative 5 has the most recommended wilderness. While grazing is allowed in wilderness, the ability to do vegetation restoration work is impacted, which restricts the potential to improve forests and grasslands for grazing purposes. Sheep animal unit months have been constant over time both in drought years and wet years, so no change is expected. While, there are differences in management and resulting available forage, the estimated economic impacts are only minimally different from action alternatives 2 and 3. Alternative 5 would support approximately 253 jobs and \$4.5 million in labor income in the local economy, annually.

Timber: Alternative 5 would be expected to produce identical timber and other wood product volumes as alternative 2. Additional areas would be recommended for wilderness, that would restrict access or mechanical means to cut fuelwood and other forest products, which could limit access to wood products,

but would not have significant impacts on opportunities to harvest commercial timber. Therefore, alternative 5 would also support 244 jobs and \$1.9 million in labor income in the local economy, annually.

Cumulative Environmental Consequences for Socioeconomics

The timeframe for the economic cumulative effects analysis is the next 10 to 15 years and the geographic scope for the economic cumulative effects analysis is the seven-county region identified previously. This analysis considers how past, present, and reasonably foreseeable future actions on lands throughout the region may interact with decisions made under the proposed plan to affect the social and economic environment. The economic analysis of the proposed plan is unique among the resources and uses in that the effects occur primarily off the forest. In this way, the indirect effects described above are cumulative in nature—they evaluate the role of Forest Service decisions under the proposed plan both on and off the Carson. However, the indirect effects analysis does not address how actions taken on adjacent lands would affect the economic consequences of the proposed plan.

The proposed plan emphasizes vegetation restoration under all alternatives. Current and proposed plans on adjacent National Forest System lands also emphasize ecosystem restoration. The scale of the proposed treatments (on Carson and adjacent lands) is expected to draw new forest product harvesting and processing industry to the region to support restoration. The timber harvest levels presented in the environmental consequences section are estimates of potential. The regional timber industry will need to expand to support increased restoration efforts. The degree to which this occurs will influence the level of realized local economic impact. Broad societal interest in backing restoration is likely to bring money to the local economy as work is funded on the Carson by outside partners.

The recreation-related effects identified in the economic environmental consequences section may be influenced by trends and activities that occur off the forest. Under all alternatives, the proposed plan supports diverse and sustainable recreational opportunities on the forest. Increased recreational use on the Carson would lead to a higher economic impact than predicted in the indirect effects discussion. Population growth in the surrounding communities can contribute to high recreation visitation as well as changes in preferences for the types and qualities of recreation supported on the Carson.

The profitability of livestock grazing is influenced by complex international market conditions and subject to changing consumer preferences and values. Small, local livestock producers compete with large industrial operations, but may be favored by consumers who value higher quality, locally grown animals. The social value of ranching, keeping land in the family, and upholding traditional values can be as strong connection to a rural ranching way of life in northern New Mexico as the pure economic benefit, but ranchers struggle with the problems and challenges of population growth on urbanization and land values, property taxes, water availability, and attitudes concerning ranching.

Changing demographics and easier access have the potential to reshape the economies of small northern New Mexico communities. Populations are aging and many homes are seasonally occupied. The percentage of workers between the ages of 25 and 54 declined by 24 percent in Taos County and 17 percent in Rio Arriba County between 2000 and 2017 (US CB 2019), reflecting a desire by working age residents to seek opportunities in more populated and thriving markets. While farming as an economic base has been declining in the rural American West (US CB 2014), it has increased over the last decade in the region around the Carson (Headwater Economics 2015). The recreational opportunities and natural amenities in northern New Mexico are a significant force that could influence future demographics. Counties with nearby recreation are attractive to mobile retirees and are some of the fastest growing in rural areas (US CB 2014). Recreation driven growth also brings challenges of increased use of environmentally sensitive areas, expanding wildland-urban interface, and a seasonally variable population that can stress local infrastructure (US CB 2014).

Amidst its future challenges and opportunities, northern New Mexico has a resilient social fabric woven on a warp of land ownership, long family history, and agricultural connection to the land. Native American and Catholic religion and ceremony are deeply rooted in landscapes and places with a bond of powerful cultural inertia. The unique history and culture in northern New Mexico is recognized by the state, nationally, and internationally, with formal designations such as the Northern Rio Grande National Heritage Area and UNESCO World Heritage site recognition for the Taos Pueblo. That social setting will persist and continue to shape communities and land management in the future.

Environmental Justice

Description of Affected Environment

In 1994, President Clinton issued Executive Order 12898. This order directs Federal agencies to focus attention on the human health and environmental conditions in minority and low-income communities. The purpose of Executive Order 12898 is to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects on minority and low-income populations.

Environmental justice includes the fair treatment and meaningful involvement of people of all races, cultures, national origin, and incomes, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies (US EPA 2013). Incorporating environmental justice considerations into the planning process helps make Forest Service resources and programs accessible to all Americans, regardless of race, economic status, or ethnicity (Grinspoon et al. 2014). The goal of environmental justice is for Federal agency decision-makers to identify impacts that are disproportionately high and adverse with respect to minority and low-income populations and identify alternatives that would avoid or mitigate those impacts. The terms environmental justice, minority, minority population, low-income population, and environmental effects are defined in the Glossary.

The emphasis of environmental justice is on health effects and/or the benefits of a healthy environment. The Council on Environmental Quality (CEQ) has interpreted health effects with a broad definition: “Such effects may include ecological, cultural, human health, economic or social impacts on minority communities, low-income communities, or Indian Tribes...when those impacts are interrelated to impacts on the natural or physical environment” (CEQ 1997).

Cultural diversity is rich and evident in northern New Mexico; however, when it comes to race, diversity is not as prevalent within the assessment area. Those who identify as White dominate the racial make-up of the area at 68.7 percent (US CB 2014). Some other race alone makes up the second largest percentage at 18.6 percent (table 83). Some other race alone includes those persons who did not classify themselves with any of the other racial categories. Less than 1 percent of racial variability can be found in races such as Black, African American, Pacific Islander, or Asian.

The third highest racial percentage in the assessment area can be found among the Native American Tribes at 9.1 percent. Though this percentage may seem small, the Native American culture is a significant part of, and influence in the assessment area. This has been touched upon in the [Cultural and Historic Resources and Use Associated with the Carson National Forest](#) section of this chapter and more discussion can also be found in the [Areas of Tribal Importance](#) section.

Table 84 shows the Native American composition of the assessment area. While it is comparable to the State of New Mexico, there is a much higher concentration of Native Americans as compared to rest of the United States.

In addition to racial identification, there is also cultural identification or ethnicity. Within the assessment area, nearly 62.9 percent of the population identifies itself as Hispanic or Latino, while just over

16 percent of the United States identifies as such. The term “Hispanic” refers to a cultural identification, and Hispanics can be of any race based on how this data was collected. The portion of the New Mexico population that identifies as Hispanic is increasing. In 1990, 38 percent of New Mexico’s population was Hispanic, and by 2010, 46 percent of people identified themselves as Hispanic. Racial composition of New Mexico has also experienced change. The portion of the population that self-identifies as “White,” fell from 76 to 68 percent between 1990 and 2010. This decline has been offset by minimal increases among other racial groups; most notable are those who self-identified as “other.”

Table 83. Population and percent by race in the assessment area, New Mexico, and the United States

Race	Assessment area population	New Mexico population	U.S. population	Assessment Area (percent)	New Mexico (percent)	U.S. (percent)
Total population	91,390	2,069,709	311,536,594	NA	NA	NA
White alone	62,784	1,511,087	230,592,579	68.7	73.0	74.0
Black or African American alone	392	42,196	39,167,010	0.4	2.0	12.6
American Indian alone	8,332	189,953	2,540,309	9.1	9.2	0.8
Asian alone	425	28,034	15,231,962	0.5	1.4	4.9
Native Hawaiian & other Pacific Is. alone	12	1,477	526,347	0	0.1	0.2
Some other race alone	17,020	233,341	14,746,054	18.6	11.3	4.7
Two or more races	2,425	63,618	8,732,333	2.7	3.1	2.8

The data in this table are calculated by the American Community Survey using annual surveys conducted during 2008–2013 and are representative of average characteristics during this period (US CB 2014). NA indicates not applicable.

Table 84. American Indian and Alaska Native population and percent by race in the assessment area, New Mexico, and the United States

Native American and Alaska Native Population	Assessment area population	New Mexico population	U.S. population	Assessment Area (percent)	New Mexico (percent)	U.S. (percent)
Total population	91,390	2,069,706	311,536,594	NA	NA	NA
Total Native American	8,332	189,953	2,540,309	9.1	9.2	0.8
American Indian Tribes	7,885	180,834	1,997,487	8.6	8.7	0.6
Alaska Native Tribes	37	283	108,836	0	0	0
Non-Specific Tribes	333	6,014	363,000	0.4	0.3	0.1

The data in this table are calculated by the American Community Survey using annual surveys conducted during 2008–2013 and are representative of average characteristics during this period (US CB 2014). NA indicates not applicable.

Although Hispanics represent nearly 63 percent of the population living in counties associated with Carson, the percentage of Hispanics that make up the population has been declining since 1990. The decline in the prevalence of Hispanics has been most notable in Taos County, where the Hispanic percent of the population declined by 7 percent, between 1990 and 2000, and by another 2 percent, between 2000 and 2010. These changes in the ethnic composition of Taos County are likely driven by net migration patterns and an influx of non-Hispanics. The decline in the prevalence of Hispanics in the assessment area population is in stark contrast to trends in New Mexico; the portion of the state's population that is Hispanic has been increasing since at least 1990. The predominance of Hispanics is most notable in Mora

County (which in 2010 had a population that was 81 percent Hispanic). Colfax County is the only county surrounding the Carson with a population that is less than 50 percent Hispanic. Table 85 shows the number of people by race who self-identify as Hispanic in the assessment area, in New Mexico, and in the United States.

Table 85. Those who self-identify as Hispanic, within the assessment area (4 counties), New Mexico, and the United States

Hispanic Ethnicity	Assessment area population	New Mexico population	U.S. population	Assessment area (percent)	New Mexico (percent)	U.S. (percent)
Hispanic and Latino (any race)	57,501	966,268	51,786,591	62.9	46.7	16.6
White alone	24,649	828,574	197,050,418	27.0	40.0	63.3
Black or African American alone	367	36,710	38,093,998	0.4	1.8	12.2
American Indian alone	7,411	177,269	2,061,752	8.1	8.6	0.7
Asian alone	422	26,202	15,061,411	0.5	1.3	4.8
Native Hawaiian & other Pacific Is. alone	12	1,160	488,646	0	0.1	0.2
Some other race alone	65	3,599	606,356	0.1	0.2	0.2
Two or more races	963	29,924	6,387,422	1.1	1.4	2.1

The data in this table are calculated by the American Community Survey using annual surveys conducted during 2008–2013 and are representative of average characteristics during this period (US CB 2014).

Minority Populations

The 4-county assessment area that contains the Carson meets the definition of a minority population, as it is over 50 percent minority. This holds at the county level also (see figure 32), including in Colfax County where all minorities make up more than half the population, though Hispanics are less than half (Headwater Economics 2019). In some sub-county locations (Taos Pueblo, Picuris Pueblo, the Jicarilla Apache Nation) Native Americans make up the majority of the population.

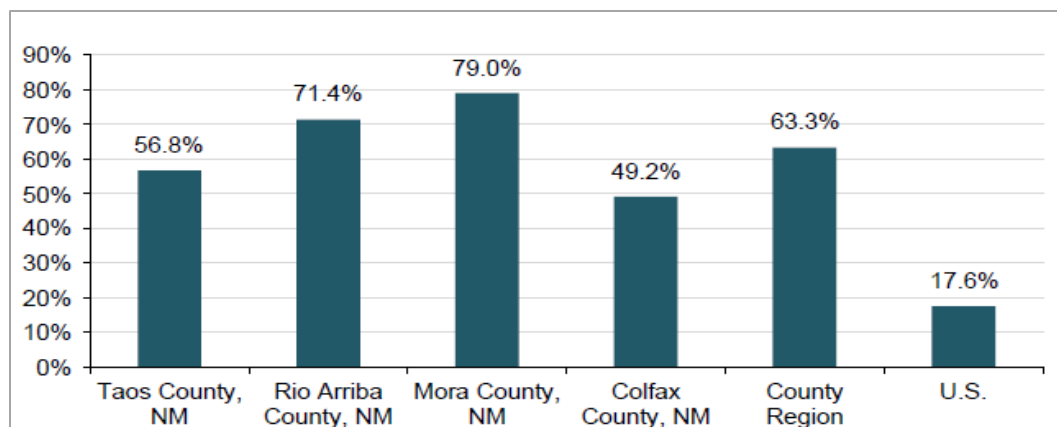


Figure 32. Hispanic population as a percent of total population, 2013-2017 average

Source: Headwater Economics (2019)

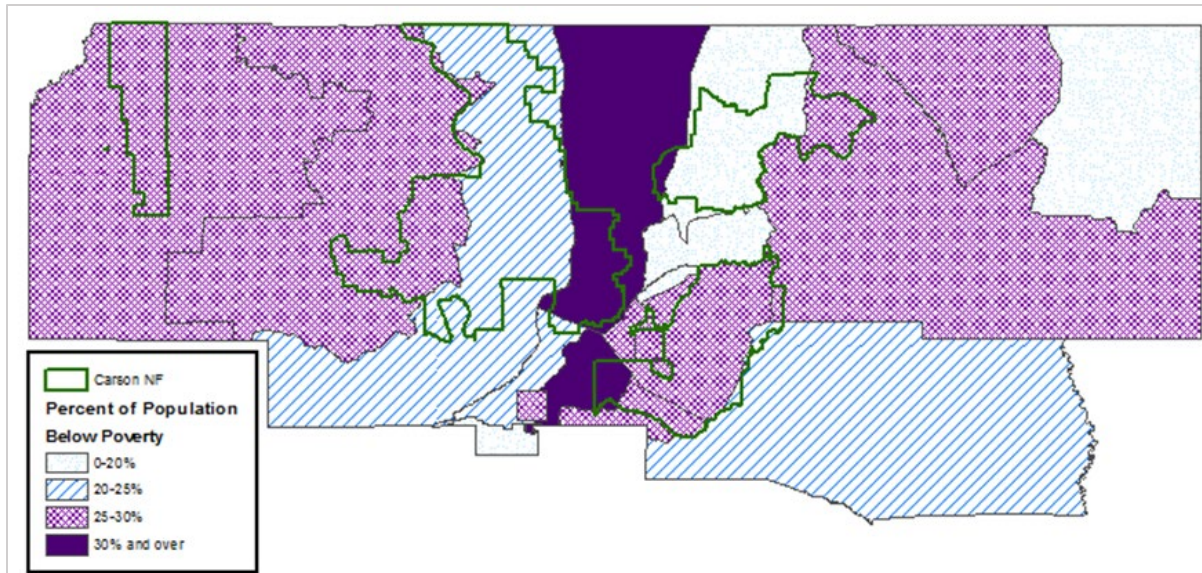


Figure 33. Percent of population living below the poverty level by census tract in 2017

Map shows all census tracts in the four counties that overlap the Carson. Source: US CB (2019)

Populations Living in Poverty

Over 20 percent of the population of New Mexico lives below the poverty line (figure 29). While Taos County is the only county among the 4 in the analysis area with a poverty rate over 25 percent, that masks finer scale patterns of poverty that exist. For example 11 of 19 census tracts have a poverty rate above 25 percent, and 3 others are above 20 percent (see figure 33). Within those areas with lower poverty overall there are communities where poverty rates are high. In 2017 Colfax and Rio Arriba Counties had poverty rates above 25 percent among the Hispanic population, and all four counties had poverty rates of over 25 percent among the Native American population (US CB 2019).

Environmental Justice Community Inclusion

The Carson's process to develop a revised plan has gone beyond routine practices and minimum notice and comment requirements in order to achieve meaningful involvement of the environmental justice populations that exist around the Carson. Before initiating the assessment phase of plan revision, a Forest Service collaboration cadre held meetings in communities around the Carson to listen to the local population; to identify and define environmental justice issues and concerns; and to determine the best methods, times, and locations to engage in public involvement. During the assessment phase, the Carson went out to small, environmental justice communities to collect local knowledge of the area, understand benefits those communities gained by using and living near the forest, and better understand baseline conditions. Throughout the planning process, the Carson advertised these meetings on local radio and in local newspapers to better reach rural populations. Flyers were posted at post offices and other community buildings. At these meetings, individuals were available who could translate into Spanish when necessary and meetings were advertised in both English and Spanish. Meetings often used small-group break-out sessions to ensure representation.

The process has sought to bridge cultural and economic differences that could affect participation by holding meetings at different times of day, repeating meetings in multiple small communities around the forest, and attending meetings convened by local leaders and groups. The preliminary draft plan has been translated into Spanish, as will other versions. Paper copies of the assessment, evaluations, and draft

versions of the plan were available at district offices. District offices also accepted comments during regular business hours.

Throughout the planning process, the Carson worked very closely with community leaders of land grants, acequias, grazing associations, tribes, and local government officials to help represent the interests of environmental justice communities. Formal consultation was done with 16 federally recognized tribes. The planning team attended 3 tribal roundtables as well as quarterly meetings with the five northern New Mexico tribes. Taos and Picuris Pueblos, the New Mexico State Acequia Commission, the New Mexico Land Grant Council, and the four overlapping counties all participated as cooperating agencies in a government working group that provided feedback on draft documents, helped convene and facilitate public meetings, and outreached to their constituencies. While not every person that these groups represent is part of an environmental justice population, there is significant overlap and through these existing networks the Carson was able to reach and meaningfully involve a much broader segment of that population.

Environmental Consequences for Environmental Justice

Methodology and Analysis

Plan components in each alternative are used to evaluate or predict short- and/or long-term effects to environmental justice issues on the Carson. Probable management activities are evaluated in relation to their major environmental or public health impacts across the alternatives for the environmental justice population. Environmental justice concerns are those that have disproportionately high and adverse impacts on minority and/or low-income populations. To determine if disproportionately high and adverse impacts exist, each alternative is evaluated against four conditions:

- Is there or will there be an impact on the natural or physical environment that significantly and adversely affects an environmental justice population;
- Are there impacts that effect environmental justice populations that appreciably exceed or are likely to appreciably exceed those on the general population or other appropriate comparison group;
- Do those impacts occur or would they occur in an environmental justice population affected by cumulative or multiple adverse exposures from environmental hazards; and
- Are minority and low-income populations affected by an alternative in different ways than the general population?

Assumptions

The effects on local Hispanic, Native American, other minority, and low income populations is not expected to be a primary driver in selecting one alternative over another, because predicted impacts between alternatives with regard to environmental justice communities are not dramatically different. Differences among alternatives are small because:

- All alternatives are expected to achieve desired conditions that contribute to opportunity for environmental justice communities in the proposed plan.
- All projects implemented on the forest would require a site-specific analysis of their potential impacts to environmental justice communities.
- None of the alternatives authorizes specific actions that would contribute to social, cultural, and economic opportunity for local environmental justice communities during the life of the plan. Proposals would be considered through project-level planning.

- None of the alternatives prohibit future site-specific project planning that may contribute to social, cultural, and economic opportunity for local environmental justice communities.

Environmental Consequences for Environmental Justice

Much of the population surrounding the Carson qualifies as an environmental justice community, either because of minority or income status. Thus, all actions taken by the forest that impact local communities are likely to impact an environmental justice community. None of the alternatives are likely to have significant adverse effects on local communities. In the action alternatives there is extensive plan direction regarding the Carson's contribution to local economies and traditional uses which would benefit the general local population, but environmental justice communities in particular. For the most part the alternatives do not create additional environmental hazards that would disproportionately impact environmental justice communities.

Several exceptions include greater environmental hazard from increased high-severity fire in alternative 3, lack of road maintenance under alternative 1, or increased smoke production under all action alternatives. Fire and smoke could have greater impact on poor communities because of a lack of resources to prepare homes, a lack of local firefighting resources, and an inability to temporarily relocate to avoid smoke impacts. Visitor use fees at developed recreation sites may be a limitation to low-income users, encouraging use at undeveloped, less managed sites. Use fees may become a greater limitation if they increase in the future in response to increased total recreational use.

The economic impact that the Carson has on surrounding communities is particularly vulnerable to climate change. The Carson is a relatively large employer and source of income among national forests in the region, and a large portion of this contribution is from snow-dependent winter recreation (Hand et al. 2018). The adaptive capacity of the relatively rural, poor counties that the Carson impacts economically is moderate at best, with some parts of those counties having very limited community resources and infrastructure that is vulnerable to disruption (Gowda et al. 2018; Hand et al. 2018). Livelihoods and wellbeing that are based on the close interconnected social and ecological fabric of northern New Mexico could be easily disrupted by changing climate (Jantarasami et al. 2018).

The current 1986 Forest Plan does not have plan language that directly acknowledges or values the uniqueness of the culture of rural historic communities and federally recognized tribes (including Hispanic and Native American people) who live within and around the Carson. There is no plan recognition of the contribution of forest management to their social, cultural, and economic way of life. Alternative 1 does not have plan language to acknowledge or encourage partnering and collaborating on projects of importance to local communities. While there is some direction in alternative 1 about making forest products available to local communities, it does not directly address the needs and values of the Hispanic and Native American communities who have been present and have used the forest for generations. The action alternatives all include this type of language which would result in forest management that considers the needs of the smaller, poorer local communities, including many environmental justice communities, but also the population generally.

The action alternatives include desired conditions that emphasize partnering and collaborating with local communities, non-governmental organizations, and other government entities when identifying and planning projects on the forest. The plan language that considers the social, cultural, and economic needs of the Hispanic and Native American communities would encourage the forest to partner with and balance the needs of these communities with other uses of the forest. Partnering opportunities for larger vegetation and watershed restoration work would consider the benefits to rural areas as well as more populated communities. Forest management that focuses both on small communities and larger communities would help to contribute to opportunities in smaller, poorer communities.

In many of the poor, rural communities in northern New Mexico many people rely on fuelwood to heat their homes. Natural gas is not available in rural areas and propane can be very expensive. Limitations on forest access under alternative 4 could decrease fuelwood availability for some environmental justice communities and could impact the ability to heat their homes if they cannot afford propane. Alternative 3 would allow the most fuelwood access but would also create more impact to other ecological resources important to environmental justice communities, such as river water quality. Under all alternatives, fuelwood would be available to environmental justice communities, and any decisions about future road openings or closures would have to account for impacts to access.

Cumulative Environmental Consequences for Environmental Justice

Executive Order 12898, Environmental Justice for Low Income and Minority Populations applies to all Federal agencies, including the Environmental Protection Agency, the Army Corps of Engineers, the Department of Interior, and the Department of Agriculture. Agencies are required to make achieving environmental justice part of their mission by identifying and addressing, as appropriate, disproportionately high adverse human health or environmental effects from their activities on minority and low-income populations. The order requires agencies to work to ensure effective public participation and access to information, including Spanish or other language translation.

In 2005 the State of New Mexico adopted Executive Order 2005-056, which sets out similar requirements for state cabinet-level departments, boards, and commissions. The State must use environmental and public health data to determine siting, permitting, compliance, enforcement, and remediation of existing and proposed industrial and commercial facilities. The order also created the Environmental Justice Task Force that includes representation by the U.S. Department of Agriculture. The task force advises State Agencies regarding actions to address environmental justice issues consistent with agencies' existing statutory and regulatory authority (NM 2005a).

Neither executive order can eliminate all disproportionate exposure or remove environmental hazards and risks, but together they provide a framework in northern New Mexico for meaningful opportunities for involvement for all people regardless of race, ethnicity, or income. There is a focus by land managers in northern New Mexico on collaborative policy development, working with Federal and local agencies, tribal governments, and representatives of environmental justice communities.

Short-term Uses and Long-term Productivity

The National Environmental Policy Act requires consideration of "the relationship between short-term uses of man's environment and the maintenance and enhancement of long-term productivity" (40 CFR 1502.16). As declared by Congress, this includes using all practicable means and measures, including financial and technical assistance, in a manner calculated to foster and promote the general welfare, to create and maintain conditions under which people and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans (NEPA Section 101).

The revised plan would govern management of the Carson's resources for the next 10 to 15 years. The EIS discloses the analysis of effects for a range of alternatives, including no action. It considers effects on the significant issues and other resources for this timeframe. Overall, under all alternatives, design and implementation of projects and activities consistent with the standards and guidelines and the use of best management practices would ensure the long-term productivity, ecological integrity, and ecological diversity of NFS lands within the Carson.

Unavoidable Adverse Effects

The plan provides a programmatic framework that guides site-specific actions but does not authorize, fund, or carry out any project or activity. Before any ground-disturbing actions take place, they must be authorized in a subsequent site-specific environmental analysis. Therefore, none of the alternatives cause unavoidable adverse impacts.

Irreversible and Irrecoverable Commitments of Resources

Irreversible commitments of resources are those that cannot be regained, such as the extinction of a species or the removal of mined ore. Irrecoverable commitments are those that are lost for a period of time such as the temporary loss of timber productivity in forested areas that are kept clear for use as a power line rights-of-way or road.

The plan provides a programmatic framework that guides site-specific actions but does not authorize, fund, or carry out any project or activity. Because the plan does not authorize or mandate any site-specific project or activity (including ground-disturbing actions), none of the alternatives cause an irreversible or irrecoverable commitment of resources.

Laws Requiring Consultation

The regulations for implementing the National Environmental Policy Act at 40 CFR 1502.25(a) direct “to the fullest extent possible, agencies shall prepare draft environmental impact statements concurrently with and integrated with . . . other environmental review laws and executive orders.” As a proposed Federal project, the revised plan decisions are subject to compliance with other Federal and State laws. Determinations and decisions made in the draft land management plan have been evaluated in the context of relevant laws and executive orders. Throughout the development of the revised plan, there has been collaboration with various State and Federal agencies. The following actions have been taken to document and ensure compliance with laws that require consultation, concurrence, or both with other Federal agencies.

- Endangered Species Act, Section 7: Consultation with the U.S. Fish and Wildlife Service, regarding federally listed threatened, endangered, and proposed species, and designated and proposed critical habitat is in progress. A biological assessment for federally listed species will be prepared and submitted to the U.S. Fish and Wildlife Service for consultation according to the Endangered Species Act. At this time the biological assessment has been drafted, and a consultation agreement has been initiated with the U.S. Fish and Wildlife Service.
- National Historic Preservation Act: Consultation with the New Mexico State Historic Preservation Officer is mandated by section 106 of the National Historic Preservation Act. The First Amended Programmatic Agreement Regarding Historic Property Protection and Responsibilities among the New Mexico State Historic Preservation Officer, and the Arizona State Historic Preservation Officer, and the Texas State Historic Preservation Officer, and the Oklahoma State Historic Preservation Officer, and the Advisory Council on Historic Preservation, and United States Department of Agriculture, Forest Service Region 3 was executed in December 2003. This programmatic agreement prescribes the manner in which region 3 and the state historic preservation officer shall cooperatively implement this programmatic agreement in New Mexico, Arizona, and portions of Texas and Oklahoma. It is intended to ensure that Region 3 organizes its programs to operate efficiently and effectively in accordance with the intent and requirements of the National Historic Preservation Act and that Region 3 integrates its historic preservation planning and management decisions with other policy and program requirements. The programmatic agreement streamlines the National Historic Preservation Act section 106 process by eliminating case-by-case consultation with the state historic

preservation officer on undertakings for which there is no or little potential to affect historic properties and for undertakings that either culminate in no historic properties affected or no historic properties adversely affected with approved standard protection measures (36 CFR 800.4(d)(1) and 800.5(d)(1)).

- Government-to-government consultation was completed with American Indian Tribes who have aboriginal territory within the lands now part of the Carson National Forest, as required by the National Historic Preservation Act; Executive Orders 13007 and 13175; and the programmatic agreement cited above. More information on this consultation can be found in the “Public Participation” section of chapter 1 and in the “Traditional Communities and Uses” section of chapter 3 of this document.

Preparers and Contributors

Interdisciplinary Team Members

Table 86. Interdisciplinary Team Members

Name	Title	Education and Experience
Kevin Naranjo	Forest Planner, Interdisciplinary Team Leader	M.S. Environmental Management, American Public University; B.S. Mechanical Engineering, University of Illinois, Chicago. 7 years with the USFS and 23 years of military and private sector leadership and project management.
Peter Rich	Assistant Forest Planner, Ecological Lead, Geographic Information Systems	M.S. Geography, University of New Mexico; B.A. Psychology, Johns Hopkins University. 12 years with the USFS and National Park Service.
Alyssa Radcliff	Biological Lead, Range	B.S. Wildlife and Fisheries with a minor in Range, Eastern New Mexico University; 18 years with NMDG&F, BLM, and USFS.
Audrey Kuykendall	Information, Collaboration, and Community Outreach Staff Officer, NEPA	B.S. Biological Science; 1 year of graduate botany, Union College. 28 years with USFS.
Greg Miller	Watershed Program Manager, Soil Scientist	B.S. Agriculture - Soil Science, University of Arizona. 38 years with the USFS.
Price Heiner	Forest Archeologist and Heritage Program Manager	M.A. Anthropology, University of Wyoming; B.A. Anthropology, Colorado State University. 9 years in private cultural resource management consulting and 10 years with the USFS.
Amy Simms	Recreation Program Manager, Lands, Special Uses	B.S. Natural Resource Recreation and Tourism with an emphasis in Park and Protected Area Management, Colorado State University. 15 years with USFS.
John Littlefield	Hydrologist	M.S. Geology, Northern Arizona University; B.S. Geology, Northern Arizona University. 12 years with the USGS and USFS
Lucy Maldonado	Forest Planner, NEPA, writer-editor	B.S. Range-Forest Management, Colorado State University. 26 years with the USFS and Bureau of Reclamation.
Allison Borchers	USFS Enterprise Program Economist	PhD Economics, University of Delaware. 8 years with USDA's USFS and Economic Research Service

Glossary

Adaptation. Adjustment in natural or human systems to a new or changing environment. Adaptation includes, but is not limited to, maintaining primary productivity and basic ecological functions, such as energy flow; nutrient cycling and retention; soil development and retention; predation and herbivory; and natural disturbances. Adaptation occurs primarily by organisms altering their interactions with the physical environment and other organisms.

Adaptive capacity. Ability of ecosystems to respond, cope, or adapt to disturbances and stressors, including environmental change, to maintain options for future generations. As applied to ecological systems, adaptive capacity is determined by:

- Genetic diversity within species in ecosystems, allowing for selection of individuals with traits adapted to changing environmental conditions.
- Biodiversity within the ecosystem, both in terms of species richness and relative abundance, which contributes to functional redundancies.
- The heterogeneity and integrity of ecosystems occurring as mosaics within broader-scaled landscapes or biomes, making it more likely that some areas will escape disturbance and serve as source areas for re-colonization.

Adaptive management. General framework encompassing the three phases of planning: assessment, plan development, and monitoring (36 CFR 219.5). This framework supports decision-making that meets management objectives while simultaneously accruing information to improve future management by adjusting the plan or plan implementation. Adaptive management is a structured, cyclical process for planning and decision-making in the face of uncertainty and changing conditions with feedback from monitoring, which includes using the planning process to actively test assumptions, track relevant conditions over time, and measure management effectiveness.

Administrative Use. Motorized use by Forest Service employees, permittees, or contractors of roads, trails, and areas not otherwise designated for motor vehicle use but required for the administration and protection of NFS lands.

Airshed. Geographic area that, because of topography, meteorology, or climate is frequently affected by the same air mass.

Assessment. For the purposes of the land management planning regulation at 36 CFR part 219, an assessment is the identification and evaluation of existing information to support land management planning. Assessments are not decision-making documents but provide current information on select topics relevant to the plan area, in the context of the broader landscape (36 CFR 219.19).

At-risk species. Term used in land management planning to refer to, collectively, the federally recognized threatened, endangered, proposed, and candidate species and species of conservation concern within a plan area.

Authorized livestock numbers. Year-to-year actual stocking of livestock on a grazing allotment, based on forage and water availability, condition of range improvements, climatic conditions, personal convenience for the permit holder, or resource protection. Authorized numbers are not necessarily the number on the permit.

Base property (grazing). Land and improvements owned and used by the permit holder for a farm or ranch operation and specifically designated by the permit holder to qualify for a term grazing permit.

Best management practices (BMPs). Methods, measures, or practices selected by an agency to meet its nonpoint source control needs. Best management practices include but are not limited to structural and nonstructural controls and operation and maintenance procedures. Best management practices can be applied before, during, and after pollution-producing activities to reduce or eliminate the introduction of pollutants into receiving waters (36 CFR 219.19).

Broader landscape. For land management planning pursuant to 36 CFR 219, the plan area and the lands surrounding the plan area. The spatial scale of the broader landscape varies depending upon the social, economic, and ecological issues under consideration.

Candidate species (36 CFR 219.19).

For species under the purview of the U.S. Fish and Wildlife Service (USFWS), a species for which the USFWS possesses sufficient information on vulnerability and threats to support a proposal to list as endangered or threatened, but for which no proposed rule has yet been published by the USFWS.

For species under the purview of the National Marine Fisheries Service (NMFS), a species that is:

- a. The subject of a petition to list as a threatened or endangered species and for which the NMFS has determined that listing may be warranted, pursuant to section 4(b)(3)(A) of the Endangered Species Act (16 U.S.C. 1533(b)(3)(A)), or
- b. Not the subject of a petition but for which the NMFS has announced in the Federal Register the initiation of a status review.

Cienega. Wet meadows and marshes that are supported by springs and groundwater seeps in arid and semi-arid regions, and generally occur at elevations below 2,000 meters [6,652 feet] (Sivinski 2018).

Climate change. Change in global or regional climate patterns, in particular a change apparent from the mid to late 20th century onward and attributed largely to the increased levels of atmospheric carbon dioxide.

Coarse woody debris. Fallen dead trees and the remains of large branches on the ground in forests and in rivers or wetlands.

Collaboration or collaborative process. A structured manner in which people with diverse interests share knowledge, ideas, and resources, while working together in an inclusive and cooperative manner toward a common purpose. Collaboration, in the context of the land management planning regulation at 36 CFR part 219, falls within the full spectrum of public engagement described in the Council on Environmental Quality's publication of October 2007: *Collaboration in NEPA—A Handbook for NEPA Practitioners* (36 CFR 219.19).

Common variety mineral materials. Collective term to describe petrified wood and common varieties of sand, gravel, stone, pumice, pumicite, cinders, clay, and other similar materials. Common varieties do not include deposits of those materials, which are valuable because of some property giving them distinct and special value.

Connectivity. Ecological conditions that exist at several spatial and temporal scales that provide landscape linkages that permit the exchange of flow, sediments, and nutrients; the daily and seasonal movements of animals within home ranges; the dispersal and genetic interchange between populations; and the long distance range shifts of species, such as in response to climate change (36 CFR 219.19).

Conservation. The protection, preservation, management, or restoration of natural environments, ecological communities, and species (36 CFR 219.19).

Conserve. For the purpose of meeting the requirements of 36 CFR 219.9, to protect, preserve, manage, or restore natural environments and ecological communities to potentially avoid federally listing of proposed and candidate species (36 CFR 219.19).

Community Wildfire Protection Plan. A comprehensive community-based planning and prioritization approach for protecting life, property, and critical infrastructure in the wildland-urban interface. Protection plans may take a variety of forms based on the needs of the community, but must be collaboratively developed, identify and prioritize areas for hazardous fuel reduction treatments, recommend treatment types and methods, and recommend measures that homeowners and communities can take to reduce the ignitability of structures. The planning process may also identify management options and implications in the surrounding landscape. The Healthy Forests Restoration Act of 2003 instructed the Forest Service to give consideration of community priorities as outlined in a county wildfire protection plan during planning and implementing hazardous fuel reduction projects.

Critical habitat. For a threatened or endangered species, (1) the specific areas within the geographical area occupied by the species at the time it is listed in accordance with the provisions of section 4 of the Endangered Species Act (ESA) (16 U.S.C. 1533), on which are found those physical or biological features (a) essential to the conservation of the species, and (b) which may require special management considerations or protection; and (2) specific areas outside the geographical area occupied by the species at the time it is listed in accordance with the provisions of section 4 of the ESA (16 U.S.C. 1533), upon a determination by the Secretary that such areas are essential for the conservation of the species. ESA, sec. 3 (5)(A), (16 U.S.C. 1532 (3)(5)(A)). Critical habitat is designated through rulemaking by the Secretary of the Interior or Commerce. ESA, sec. 4 (a)(3) and (b)(2) (16 U.S.C. 1533 (a)(3) and (b)(2)).

Decision document. Record of decision, decision notice, or decision memo (36 CFR 220.3).

Decommission. The demolition, dismantling, removal, obliteration, and or disposal of an otherwise unneeded asset in such a manner so as to no longer function as intended. Usually in reference to decommissioning of a road so that it no longer requires maintenance and is not apparent on the landscape.

Departure. Degree to which the current condition of a key ecosystem characteristic is unlike the desired condition.

Designated area. Area or feature identified and managed to maintain its unique special character or purpose. Some categories of designated areas may be designated only by statute and some categories may be established administratively in the land management planning process or by other administrative processes of the Federal executive branch. Examples of statutorily designated areas are national heritage areas, national recreational areas, national scenic trails, wild and scenic rivers, wilderness, and wilderness study areas. Examples of administratively designated areas are experimental forests, research natural areas, scenic byways, botanical areas, and significant caves (36 CFR 219.19).

Designated road, trail, or area. A National Forest System road, a National Forest System trail, or an area on National Forest System lands that is designated for motor vehicle use pursuant to 36 CFR 212.51 on a motor vehicle use map (36 CFR 212.1).

Desirable nonnative. Nonnative species that were intentionally released into the wild to establish self-sustaining populations of wildlife that meet public demands for recreation or other purposes (e.g., sport fishes). These desirable nonnative species are not likely to cause ecosystem disruption.

Desired conditions. For the purposes of the land management planning regulation at 36 CFR 219, a description of specific social, economic, and ecological characteristics of the plan area, or a portion of the plan area, toward which management of the land and resources should be directed. Desired conditions must be described in terms that are specific enough to allow progress toward their achievement to be

determined, but do not include completion dates (36 CFR 219.7(e)(1)(i)). Desired conditions are achievable, and may reflect social, economic, or ecological attributes, including ecosystem processes and functions.

Disturbance. Any relatively discrete event in time that disrupts ecosystem, watershed, community, or species population structure or function and changes resources, substrate availability, or the physical environment (36 CFR 219.19).

Disturbance regime. Description of the characteristic types of disturbance on a given landscape; the frequency, severity, and size distribution of these characteristic disturbance types; and their interactions (36 CFR 219.19).

Easement. Type of special use authorization (usually granted for linear rights-of-way) that is utilized in those situations where a conveyance of a limited and transferable interest in National Forest System land is necessary or desirable to serve or facilitate authorized long-term uses, and that may be compensable according to its terms (36 CFR 251.51).

Ecological conditions. Biological and physical environment that can affect the diversity of plant and animal communities, the persistence of native species, and the productive capacity of ecological systems. Ecological conditions include habitat and other influences on species and the environment. Examples include the abundance and distribution of aquatic and terrestrial habitats, connectivity, roads and other structural developments, human uses, and invasive species (36 CFR 219.19).

Ecological function. Biological, chemical, and physical processes and components that take place or occur within an ecosystem.

Ecological integrity. Quality or condition of an ecosystem when its dominant ecological characteristics (e.g., composition, structure, function, connectivity, and species composition and diversity) occur within the natural range of variability and can withstand and recover from most perturbations imposed by natural environmental dynamics or human influence (36 CFR 219.19).

Ecological process. Physical, chemical, and biological actions or events that link organisms and their environment including decomposition, production (of plant matter), nutrient cycling, and fluxes of nutrients and energy.

Ecological response unit (ERU). Classification of a unit of land that groups sites by similar plant species composition, succession patterns, and disturbance regimes, such that similar units will respond in a similar way to disturbance, biological processes, or manipulation. Each ERU characterizes sites with similar composition, structure, function, and connectivity, and defines their spatial distribution on the landscape.

Ecological sustainability. See sustainability.

Ecological system. See ecosystem.

Economic sustainability. See sustainability.

Ecosystem. (36 CFR 219.19) Spatially explicit, relatively homogeneous unit of the Earth that includes all interacting organisms and elements of the abiotic environment within its boundaries. An ecosystem is commonly described in terms of its:

1. Composition. Biological elements within the different levels of biological organization, from genes and species to communities and ecosystems.

2. **Structure.** Organization and physical arrangement of biological elements, such as, snags and down woody debris, vertical and horizontal distribution of vegetation, stream habitat complexity, landscape pattern, and connectivity.
3. **Function.** Ecological processes that sustain composition and structure, such as energy flow, nutrient cycling and retention, soil development and retention, predation and herbivory, and natural disturbances, such as wind, fire, and floods.
4. **Connectivity.** See connectivity above.

Ecosystem diversity. The variety and relative extent of ecosystems (36 CFR 219.19).

Ecosystem integrity. See ecological integrity.

Ecosystem services. Benefits people obtain from ecosystems, including:

- Provisioning services, such as clean air and fresh water, energy, food, fuel, forage, wood products or fiber, and minerals;
- Regulating services, such as long-term storage of carbon; climate regulation; water filtration, purification, and storage; soil stabilization; flood and drought control; and disease regulation;
- Supporting services, such as pollination, seed dispersal, soil formation, and nutrient cycling; and
- Cultural services, such as educational, aesthetic, spiritual, and cultural heritage values, recreational experiences, and tourism opportunities.

Encroachment. An increase in the density and cover of trees or shrubs in grasslands that reduces grass biomass, density, and cover.

Endangered species. Any species that the Secretary of the Interior or the Secretary of Commerce has determined is in danger of extinction throughout all or a significant portion of its range. Endangered species are listed at 50 CFR sections 17.11, 17.12, and 224.101.

Environmental impacts. Possible effects caused by a development, industrial, or infrastructural project or by the release of a substance in the environment.

Environmental justice. Fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies (U.S. EPA 2013). Fair treatment means that environmental justice populations do not bear a greater burden of environmental harms and risks than the general population from Forest Service programs and policies.

Meaningful involvement has four parts:

1. Potentially affected environmental justice populations have opportunities to participate in decision-making processes affecting their environment or health;
2. Contributions of environmental justice populations may influence the agency's decision;
3. Concerns of all participants are considered in the decision-making process; and
4. Decision makers seek out and facilitate the involvement of environmental justice populations (U.S. EPA 2010).

Ephemeral stream. Stream that flows only in direct response to precipitation in the immediate locality (watershed or catchment basin), and whose channel is at all other times above the zone of saturation.

Even-aged stand. Stand of trees comprising a single age class (36 CFR 219.19).

Federally recognized tribe. Indian or Alaska native tribe, band, nation, pueblo, village, or community that the Secretary of the Interior acknowledges to exist as an Indian tribe under the Federally Recognized Indian Tribe List Act of 1994, 25 U.S.C. 479a (36 CFR 219.19).

Fire regime. Pattern, frequency, and intensity of wildfire that prevails in an area over long periods of time.

Forest road or trail. A road or trail wholly or partly within or adjacent to and serving the National Forest System that the Forest Service determines is necessary for the protection, administration, and utilization of the National Forest System and the use and development of its resources (36 CFR 212.1).

Frequent fire-dependent ecosystem. Vegetation community that requires a fire regime 1 (over 35-year fire frequency), to maintain its natural function, structure, and species composition.

Functional ecosystem. System with intact abiotic and biotic processes. Function focuses on the underlying processes that may be degraded, regardless of the structural condition of the ecosystem. Functionally restored ecosystems may have a different structure and composition than the historical reference condition. As contrasted with ecological restoration that tends to seek historical reference condition, function refers to the dynamic processes that drive structural and compositional patterns. Functional restoration is the manipulation of interactions among process, structure, and composition in a degraded ecosystem to improve its operations. Functional restoration aims to restore functions and improve structures with a long-term goal of restoring interactions between function and structure. It may be, however, that a functionally restored system will look quite different than the reference condition in terms of structure and composition and these disparities cannot be easily corrected because some threshold of degradation has been crossed or the environmental drivers, such as climate, that influenced structural and (especially) compositional development have changed.

Groundcover. Layer of dead and living vegetation that provides protection of the topsoil from erosion and drought.

Groundwater-dependent ecosystem. Community of plants, animals, and other organisms whose extent and life processes depend on groundwater. Examples include many wetlands, groundwater-fed lakes and streams, cave and karst systems, aquifer systems, springs, and seeps.

Habitat fragmentation. Process by which habitat loss results in the division of large, continuous habitats into smaller more isolated remnants.

Habitat type. A land or aquatic unit, consisting of an aggregation of habitats having equivalent structure, function, and responses to disturbance.

Historic properties. Any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion on the National Register of Historic Places.

Hydrologic unit code (HUC). A unique hierarchical hydrologic unit based on the area of land that drains to a single stream mouth or outlet at each level, and nested levels are identified by successively longer codes. A HUC 8 subbasin is 700 square miles or larger and is divided into multiple HUC 10 watersheds that range from 62 to 390 square miles. HUC 12 subwatersheds are 15 to 62 square miles and nest inside HUC 10 watersheds. (usgs.gov)

Infill. An increase in trees per acre in forests and woodlands, resulting in a decrease in the quality and size of interspaces.

Information. For information collection from the public pursuant to 5 CFR part 1320, any statement or estimate of fact or opinion, regardless of form or format, whether in numerical, graphic, or narrative form, and whether oral or maintained on paper, electronic or other media. Information does not generally include items in the following categories; however, the Office of Management and Budget (OMB) may determine that any specific item constitutes “information”:

- Affidavits, oaths, affirmations, certifications, receipts, changes of address, consents, or acknowledgments; provided that they entail no burden other than that necessary to identify the respondent, the date, the respondent's address, and the nature of the instrument (by contrast, a certification would likely involve the collection of “information” if an agency conducted or sponsored it as a substitute for a collection of information to collect evidence of, or to monitor, compliance with regulatory standards, because such a certification would generally entail burden in addition to that necessary to identify the respondent, the date, the respondent's address, and the nature of the instrument);
- Samples of products or of any other physical objects;
- Facts or opinions obtained through direct observation by an employee or agent of the sponsoring agency or through nonstandardized oral communication in connection with such direct observations;
- Facts or opinions submitted in response to general solicitations of comments from the public, published in the Federal Register or other publications, regardless of the form or format thereof, provided that no person is required to supply specific information pertaining to the commenter, other than that necessary for self-identification, as a condition of the agency's full consideration of the comment;
- Facts or opinions obtained initially or in follow-on requests, from individuals (including individuals in control groups) under treatment or clinical examination in connection with research on or prophylaxis to prevent a clinical disorder, direct treatment of that disorder, or the interpretation of biological analyses of body fluids, tissues, or other specimens, or the identification or classification of such specimens;
- A request for facts or opinions addressed to a single person;
- Examinations designed to test the aptitude, abilities, or knowledge of the persons tested and the collection of information for identification or classification in connection with such examinations;
- Facts or opinions obtained or solicited at or in connection with public hearings or meetings;
- Facts or opinions obtained or solicited through nonstandardized follow-up questions designed to clarify responses to approved collections of information; and
- Like items so designated by OMB (5 CFR 1320.3(h)).

Infrastructure. Infrastructure the Forest manages includes all vertical and horizontal constructed structures. Infrastructure is broken into three categories:

1. Transportation infrastructure includes both the road and trail systems. The road system infrastructure is all Forest Service roads, drainage ditches, culverts, signage, and bridges. The trail system includes all motorized and non-motorized trails, signage, and bridges.
2. Facilities infrastructure includes administrative and recreation building and sites (e.g., driveways, parking, landscaping); support utilities (e.g., electrical, water, wastewater); dams, and other support buildings.
3. Other infrastructure directly supports natural resources, which includes fish barriers, wildlife drinkers, and range infrastructure (e.g., fencing, trick tanks, water gaps, and cattleguards).

Inherent capability of the Forest. Ecological capacity or ecological potential of an area characterized by the interrelationship of its physical elements, its climatic regime, and natural disturbances (36 CFR 219.19).

Inholding. Private property completely surrounded by National Forest System lands.

Integrated resource management. Multiple use management that recognizes the interdependence of ecological resources and is based on the need for integrated consideration of ecological, social, and economic factors (36 CFR 219.19).

Intermittent stream. Stream or reach of stream channel that flows, in its natural condition, only during certain times of the year or in several years, and is characterized by interspersed, permanent surface water areas containing aquatic flora and fauna adapted to the relatively harsh environmental conditions found in these types of environments. Intermittent streams are identified as dashed blue lines on USGS 7 1/2-inch quadrangle maps.

Invasive species. Alien species whose introduction causes or is likely to cause economic or environmental harm or harm to human health. A species that causes, or is likely to cause, harm and that is exotic to the ecosystem it has infested. Invasive species infest both aquatic and terrestrial areas and can be identified within any of the following four taxonomic categories: plants, vertebrates, invertebrates, and pathogens (Executive Order 13112).

Land grant-merced. Grant of land made by the Government of Spain or Mexico to a community, town, colony, pueblo, or person for the purpose of founding or establishing a community, town, colony, or pueblo.

Land grant-merced governing body. Community land grant-merced recognized under a State of New Mexico law, statute, or code, with a duly elected or appointed governance body charged with management, care, and protection of land grant-merced common lands.

Landscape. Defined area irrespective of ownership or other artificial boundaries, such as a spatial mosaic of terrestrial and aquatic ecosystems, landforms, and plant communities, repeated in similar form throughout such a defined area (36 CFR 219.19).

Long-term impacts. Impacts that last through the life of this plan.

Low-income population. Low-income status is determined by comparing annual income to a set of dollar values called poverty thresholds that vary by family size, number of children, and age of householder. If a family's before-tax money income is less than the dollar value of their threshold, then that family and every individual in it are in poverty. For people not living in families, poverty status is determined by comparing the individual's income to his or her poverty threshold. A low-income population is a readily identifiable group of persons living in geographic proximity at or below the thresholds set by the Census Bureau or guidelines set by the Department of Health and Human Services (U.S. DHHS 2013). Poverty thresholds are the "Dollar amounts the Census Bureau uses to determine a family's or person's poverty status." In 2013, the poverty guideline for the 48 contiguous States and the District of Columbia is \$11,490 for a one-person household and \$23,550 for a four-person household.

Maintain. In reference to an ecological condition: To keep in existence or continuance of the desired ecological condition in terms of its desired composition, structure, and processes. Depending upon the circumstance, ecological conditions may be maintained by active or passive management or both (36 CFR 219.19).

Management actions. Alterations to ecosystems or activities that the Forest Service conducts or authorizes on NFS lands. These may include mechanical thinning, prescribed burning, permitted grazing,

permitted fuelwood gathering, vehicular access, stream restoration treatments, seeding, trail construction, fencing, among others.

Management area. Land area identified within the planning area that has the same set of applicable plan components. A management area does not have to be spatially contiguous (36 CFR 219.19).

Management system. For the purposes of the land management planning regulation at 36 CFR 219, a timber management system including even aged management and uneven-aged management (36 CFR 219.19).

Mechanical treatment. Vegetation manipulation using machinery to achieve a prescribed outcome.

Memorandum of understanding. Describes a bilateral or multilateral agreement between two or more parties. It expresses a convergence of will between the parties, indicating an intended common line of action. It is often used in cases where parties either do not imply a legal commitment or in situations where the parties cannot create a legally enforceable agreement. It is a more formal alternative to a gentlemen's agreement.

Minimum requirements analysis. Required by law whenever land managers are considering a use prohibited by Section 4(c) of the Wilderness Act of 1964, and is a process that was developed by the Arthur Carhart National Wilderness Training Center to help land managers make informed, defensible decisions that comply with the Wilderness Act.

Minority. Person who is a member of the following population groups: "American Indian or Alaskan Native; Asian or Pacific Islander; Black, not of Hispanic origin; or Hispanic" (USDA 1997, p. 2).

Minority population. Either, (1) a readily identifiable group of people living in geographic proximity with a population that is 50 percent minority. The population with a 50 percent minority may be made up of one minority or a number of different minority groups; together the sum is 50 percent. Or, (2) a minority population may be an identifiable group that has a meaningfully greater minority population than the adjacent geographic areas, or may also be a geographically dispersed/transient set of individuals such as migrant workers or Native Americans (CEQ 1997).

Mitigate. To avoid, minimize, rectify, reduce, or compensate the adverse environmental impacts associated with an action.

Monitoring. Systematic process of collecting information to evaluate effects of actions or changes in conditions or relationships (36 CFR 219.19).

Motor Vehicle. Any vehicle which is self-propelled, other than:

- A vehicle operated on rails; and
- Any wheelchair or mobility device, including one that is battery-powered, that is designed solely for use by a mobility-impaired person for locomotion, and that is suitable for use in an indoor pedestrian area (36 CFR 212.1, 36 CFR 261.2).

Motor vehicle use map (MVUM). Map reflecting designated roads, trails, and areas on an administrative unit or a ranger district of the National Forest System (36 CFR 212.1).

Multiple use. Management of the various renewable surface resources of the National Forest System so that they are used in the combination that will best meet the needs of the American people; making the most judicious use of the land for some or all of these resources or related services over areas large enough to provide sufficient latitude for periodic adjustments in use to conform to changing needs and conditions; that some land will be used for less than all of the resources; and harmonious and coordinated management of the various resources, each with the other, without impairment of the productivity of the

land, with consideration being given to the relative values of the various resources, and not necessarily the combination of uses that will give the greatest dollar return or the greatest unit output, consistent with the Multiple-Use Sustained-Yield Act of 1960 (16 U.S.C. 528–531) (36 CFR 219.19).

National Environmental Policy Act (NEPA). United States environmental law (42 U.S.C. 4321 et seq.), enacted January 1, 1970, that established a U.S. national policy promoting the enhancement of the environment and “will encourage productive and enjoyable harmony between man and his environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man; to enrich the understanding of the ecological systems and natural resources important to the Nation.” Additionally, it established the President's Council on Environmental Quality (CEQ).

National Forest System. Includes national forests, national grasslands, and the national tallgrass prairie (36 CFR 219.62).

National Forest System Road. Forest Service road other than a road authorized by a legally documented right-of-way held by a State, county, or other local public road authority (36 CFR 212.1, 36 CFR 251.51, 36 CFR 261.2).

National Forest System Trail. Forest Service trail other than a trail authorized by a legally documented right-of-way held by a State, county, or other local public road authority (36 CFR 212.1).

Native species. Organism that was historically or is present in a particular ecosystem as a result of natural migratory or evolutionary processes and not as a result of an accidental or deliberate introduction into that ecosystem. An organism's presence and evolution (adaptation) in an area are determined by climate, soil, and other biotic and abiotic factors (36 CFR 219.19).

National Trail. One among a network of scenic, historic, and recreation trails designated by the National Trails System Act of 1968. These trails provide for outdoor recreation needs; promote the enjoyment, appreciation, and preservation of open-air, outdoor areas and historic resources; and encourage public access and citizen involvement.

Natural variability. Refers to past conditions and processes that provide important context and guidance relevant to the environments and habitats in which native species evolved. Disturbance-driven spatial and temporal variability is vital to ecological systems. Biologically appropriate disturbances provide for heterogeneous conditions and subsequent diversity. Conversely, uncharacteristic disturbance, such as high-intensity fire in plant communities that historically had a frequent low-intensity fire regime can have the effect of reducing diversity, increasing homogeneity, and may result in permanently altered conditions.

Naturalize. Type of road decommissioning treatment that restores natural vegetation and drainage.

Objective. Concise, measurable, and time-specific statement of a desired rate of progress toward a desired condition or conditions. Objectives should be based on reasonably foreseeable budgets.

Obliterate. Type of road decommissioning treatment that renders the road unusable and unrecognizable.

Off-highway vehicle (OHV). Any motorized vehicle designed for or capable of cross-country travel on or immediately over land, water, sand, snow, ice, marsh, swampland, or other natural terrain; except that term excludes (1) any registered motorboat, (2) any fire, military, emergency or law enforcement vehicle when used for emergency purposes, and any combat or combat support vehicle when used for national defense purposes, and (3) any vehicle whose use is expressly authorized by the respective agency head under a permit, lease, license, or contract (EO 11644 as amended by EO 11989). See also FSM 2355. 01 - Exhibit 01.

Old-growth characteristics. Old-growth forests are forests that have accumulated specific characteristics related to tree size, canopy structure, snags and woody debris, and plant associations. Ecological characteristics of old-growth forests emerge through the processes of succession. Certain features—presence of large, old trees, multilayered canopies, forest gaps, snags, woody debris, and a particular set of species that occur primarily in old-growth forests—do not appear simultaneously, nor at a fixed time in stand development. Old-growth forests support assemblages of plants and animals, environmental conditions, and ecological processes that are not found in younger forests (younger than 150 to 250 years) or in small patches of large, old trees. Specific attributes of old-growth forests develop through forest succession until the collective properties of an older forest are evident.

Online. Refers to the appropriate Forest Service website or future electronic equivalent (36 CFR 219.62).

Outstanding natural resource water (ONRW). Streams, lakes, and wetlands that receive special protection against degradation under New Mexico's water quality standards and the Federal Clean Water Act. They are designated by the Water Quality Control Commission. Waters eligible for outstanding national resource waters designation include waters that are part of a national or State park, wildlife refuge or wilderness, special trout waters, waters with exceptional recreational or ecological significance, and high-quality waters that have not been significantly modified by human activities (NMED 2015).

Outstandingly remarkable value. A scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar river-related value that is unique, rare, or exemplary feature and is significant when compared with similar values from other rivers at a regional or national scale.

Participation. Activities that include a wide range of public involvement tools and processes, such as collaboration, public meetings, open houses, workshops, and comment periods (36 CFR 219.19).

Perennial stream. Stream or reach of a channel that flows continuously or nearly so throughout the year and whose upper surface is generally lower than the top of the zone of saturation in areas adjacent to the stream. These streams are identified as solid blue on the USGS 7 1/2-inch quadrangle maps.

Permit area. Area in which an activity is authorized through a special use permit.

Permit holder or permittee. Any person or entity that has been issued a grazing or special use permit on NFS lands.

Persistence. Continued existence (36 CFR 219.19).

Plan or land management plan. Document or set of documents that provide management direction for an administrative unit of the NFS developed under the requirements of the land management planning regulation at 36 CFR part 219 or a prior planning rule (36 CFR 219.19).

Plan area. National Forest System lands covered by a plan (36 CFR 219.19); specifically, lands managed by the Forest Service as the Carson.

Plan components. Parts of a land management plan that guide future project and activity decision-making. Specific plan components may apply to the entire plan area, to specific management areas or geographic areas, or to other areas as identified in the plan. Every plan must include the following plan components: Desired conditions; Objectives; Standards; Guidelines; Suitability of Lands. A plan may also include Goals as an optional component.

Plan development. Second phase in the plan revision process. Plan development requires preparation of an environmental impact statement. It is grounded in the information developed during the assessment phase and other information relevant to the plan area, it addresses needs for change, and it involves the public. Every plan must have management areas or geographic areas or both and may identify designated or recommended designated areas (36 CFR 219.7).

Plan monitoring program. Essential part of the land management plan that sets out the plan monitoring questions and associated indicators, based on plan components. The plan monitoring program informs management of resources on the plan area and enables the responsible official to determine if a change in plan components or other plan content that guide management of resources on the plan area may be needed.

Plant and animal community. Naturally occurring assemblage of plant and animal species living within a defined area or habitat (36 CFR 219.19).

Productivity. Capacity of NFS lands and their ecological systems to provide the various renewable resources in certain amounts in perpetuity. For the purposes of the land management planning regulation at 36 CFR part 219, productivity is an ecological term, not an economic term (36 CFR 219.19).

Project. Organized effort to achieve an outcome on NFS lands identified by location, tasks, outputs, effects, times, and responsibilities for execution (36 CFR 219.19).

Properly functioning condition (PFC). PFC is a methodology for assessing the physical functioning of riparian and wetland areas. The term PFC is used to describe both the assessment process, and a defined, on-the-ground condition of a riparian-wetland area. In either case, PFC defines a minimum or starting point.

Proposed species. Any species of fish, wildlife, or plant that is proposed by the U.S. Fish and Wildlife Service or the National Marine Fisheries Service in the Federal Register to be listed under Section 4 of the Endangered Species Act. (36 CFR 219.19)

Rangelands. Forage-producing forested and non-forested lands.

Recovery. For the purposes of the land management planning regulation at 36 CFR part 219 and with respect to threatened or endangered species: The improvement in the status of a listed species to the point at which listing as federally endangered or threatened is no longer appropriate (36 CFR 219.19).

Recreation opportunity. Opportunity to participate in a specific recreation activity in a particular recreation setting to enjoy desired recreation experiences and other benefits that accrue. Recreation opportunities include non-motorized, motorized, developed, and dispersed recreation on land, water, and in the air (36 CFR 219.19).

Recreation setting and recreation opportunity spectrum (ROS). Social, managerial, and physical attributes of a place that, when combined, provides a distinct set of recreation opportunities. The Forest Service uses recreation opportunity spectrum to define desired recreation settings and categorize them into six distinct classes: Primitive, Semi-primitive Non-motorized, Semi-primitive Motorized, Roded Natural, Rural, and Urban (36 CFR 219.19).

Redundancy. Presence of multiple occurrences of ecological conditions such that not all occurrences may be eliminated by a catastrophic event.

Reference conditions. Environmental conditions that infer ecological sustainability. When available, reference conditions are represented by the characteristic natural range of variability (not the total range of variation), prior to European settlement and under the current climatic period. For many ecosystems, natural range of variability also reflects human-caused disturbance and effects prior to settlement. To be useful as a management guide it may be necessary to refine reference conditions according to contemporary factors (e.g., invasive species) or projected conditions (e.g., changes in climate patterns). Reference conditions are most useful as an inference of sustainability when they have been quantified by amount, condition, spatial distribution, and temporal variation.

Regulated timber harvest. Tree harvest for timber production, as opposed to tree harvest for other purposes, such as habitat and watershed improvement or fuelwood.

Representativeness. Presence of a full array of ecosystem types and successional states based on the physical environment and characteristic disturbance processes.

Resilience. Ability of an ecosystem and its component parts to absorb, or recover from the effects of disturbances through preservation, restoration, or improvement of its essential structures and functions and redundancy of ecological patterns across the landscape.

Responsible official. Official with the authority and responsibility to oversee the planning process and to approve a plan, plan amendment, and plan revision (36 CFR 219.62).

Restoration, ecological. Process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed. Ecological restoration focuses on reestablishing the composition, structure, pattern, and ecological processes necessary to facilitate terrestrial and aquatic ecosystems sustainability, resilience, and health under current and future conditions (36 CFR 219.19).

Restore. To renew by the process of restoration. See restoration (36 CFR 219.19).

Riparian areas. Three-dimensional ecotones [the transition zone between two adjoining communities] of interaction that include terrestrial and aquatic ecosystems that extend down into the groundwater, up above the canopy, outward across the floodplain, up the near-slopes that drain to the water, laterally into the terrestrial ecosystem, and along the water course at variable widths (36 CFR 219.19).

Riparian management zone. Portion of a watershed around lakes, perennial, intermittent, and ephemeral streams, and open water wetlands that has characteristic riparian vegetation and provides riparian function.

Risk. Combination of the likelihood that a negative outcome will occur and the severity of the subsequent negative consequences (36 CFR 219.19).

Road. Motor vehicle route over 50 inches wide, unless identified and managed as a trail (36 CFR 212.1).

Road closure. Administrative road designation that prohibits public motor vehicle use. Closures may be accompanied by road decommissioning or signage but can also be exclusively a regulatory determination (not included on a motor vehicle use map). Closed roads may be used administratively or by permit.

Road decommissioning. Activities that result in the stabilization and restoration of unneeded roads to a more natural state (36 CFR 212.1). Decommissioning includes reestablishing vegetation and, if necessary, initiating restoration of ecological processes interrupted or adversely impacted by the unneeded road by applying various treatments, including one or more of the following:

1. Reestablishing former drainage patterns, stabilizing slopes, and restoring vegetation;
2. Blocking the entrance to a road or installing water bars;
3. Removing culverts, reestablishing drainages, removing unstable fills, pulling back road shoulders, and scattering slash on the roadbed;
4. Completely eliminating the roadbed by restoring natural contours and slopes; and
5. Other methods designed to meet the specific conditions associated with the unneeded road. (FSH 7734.1)

Road Maintenance Levels:

- Maintenance level 1. Roads that are placed in storage between intermittent uses. The period of storage must exceed 1 year. These are given basic maintenance to prevent impacts to adjacent resources. Can be operated at any other maintenance level during periods of use.
- Maintenance level 2. Roads that are open and maintained for use by high-clearance vehicles; surface smoothness is not a consideration. Most have native material surface (not paved and no aggregate surface).
- Maintenance level 3. Roads that are open and maintained for use by standard passenger cars. Most have gravel surface.
- Maintenance level 4. Roads that are open and maintained for use by standard passenger cars and to provide a moderate degree of user comfort and convenience at moderate travel speeds. Most are paved or have an aggregate surface.
- Maintenance level 5. Roads that are open and maintained for use by standard passenger cars.

Road naturalization. Reestablishing former drainage patterns, stabilizing slopes, and restoring vegetation.

Road obliteration. Completely eliminating the roadbed by restoring natural contours and slopes.

Routine maintenance. Work that is planned to be accomplished on a continuing basis, generally annually or more frequently (FSH 7709.58, 13.41).

Scenery management system (SMS). Classification system that recognizes scenery as the visible expression of dynamic ecosystems functioning within places which have unique aesthetic and social values. It recognizes that in addition to naturally occurring features, positive scenery attributes associated with social, cultural, historical, and spiritual values, including human presence and the built environment, can also be valued elements of the scenery. The scenery management system also allows for seamless analysis and conservation beyond National Forest System lands into adjacent communities and other jurisdictions, through the application of varying scenery themes within a single analysis. It is structured to emphasize natural-appearing scenery.

Scenic character. Combination of the physical, biological, and cultural images that gives an area its scenic identity and contributes to its sense of place. Scenic character provides a frame of reference from which to determine scenic attractiveness and to measure scenic integrity (36 CFR 219.19).

Scenic integrity objective. Desired level of intactness and wholeness of scenic character based on physical and sociological characteristics of an area. Refers to the degree of acceptable human alteration to the character valued for its aesthetic appeal. Objectives include very high, high, moderate, and low, very low, and unacceptably low.

Seral state. One of a series of transitional plant communities that develop during gradual successive change following disturbance.

Species of conservation concern. Species other than federally recognized threatened, endangered, proposed, or candidate species that is known to occur in the plan area; and for which the regional forester has determined that the best available scientific information indicates substantial concern about the species' capability to persist over the long term in the plan area (36 CFR 219.9(c)).

Standard. Mandatory constraint on project and activity decision-making, established to help achieve or maintain the desired condition or conditions, to avoid or mitigate undesirable effects, or to meet applicable legal requirements (36 CFR 219.7 (e)(1)(iii)).

Stressors. For the purposes of the land management planning regulation at 36 CFR part 219, factors that may directly or indirectly degrade or impair ecosystem composition, structure, or ecological process in a

manner that may impair its ecological integrity, such as an invasive species, loss of connectivity, or the disruption of a natural disturbance regime (36 CFR 219.19).

Subwatershed. An HUC 12 hydrologic unit, the smallest subdivision considered in this assessment. See hydrologic unit code definition.

Sustainability. The capability to meet the needs of the present generation without compromising the ability of future generations to meet their needs. For the purposes of the land management planning regulation at 36 CFR part 219, “ecological sustainability” refers to the capability of ecosystems to maintain ecological integrity; “economic sustainability” refers to the capability of society to produce and consume or otherwise benefit from goods and services including contributions to jobs and market and nonmarket benefits; and “social sustainability” refers to the capability of society to support the network of relationships, traditions, culture, and activities that connect people to the land and to one another, and support vibrant communities (36 CFR 219.19).

Sustainable rangelands. Lands that provide forage for livestock grazing opportunities and contribute to agricultural businesses, local employment, as well as traditional and generational ties to the land.

Sustainable recreation. The set of recreation settings and opportunities on the National Forest System that is ecologically, economically, and socially sustainable for present and future generations (36 CFR 219.19).

System Road. See National Forest System Road.

System Trail. See National Forest System Trail.

Temporary road. A road authorized by contract, permit, lease, other written authorization or is necessary for emergency operations that is not a National Forest System road and not part of the Forest Service transportation system and not necessary for long-term management (36 CFR 212.1).

Temporary trail. A trail necessary for emergency operations or authorized by contract, permit, lease, or other written authorization that is not a National Forest System trail and that is not included in a forest transportation atlas.

Terrestrial ecosystem. All interacting organisms and elements of the abiotic environment in those vegetation and soil types, which are neither aquatic nor riparian.

Terrestrial ecosystem survey. Inventory of soil types or terrestrial ecosystem units on the Carson. It contains predictions and limitations of soil and vegetation behavior for selected land uses. This survey also highlights hazards or capabilities inherent in the soil and the impact of selected uses on the environment. At the context scale, upland ecological response units are derived from the Carson Terrestrial Ecosystem Survey (USDA FS Carson 1987).

Terrestrial ecosystem unit. The classification unit used in the terrestrial ecosystem survey. A spatially explicit area with a similar combination of soils, land types, and vegetation.

Threatened species. Any species that the Secretary of the Interior or the Secretary of Commerce has determined is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. Threatened species are listed at 50 CFR sections 17.11, 17.12, and 223.102.

Timber harvest. Removal of trees for wood fiber use and other multiple use purposes (36 CFR 219.19).

Timber production. Purposeful growing, tending, harvesting, and regeneration of regulated crops of trees to be cut into logs, bolts, or other round sections for industrial or consumer use (36 CFR 219.19).

Traditional community. Land-based rural community that has a long-standing history in and around the lands managed by the Forest Service.

Traditional cultural property. A property that is eligible for inclusion in the National Register of Historic Places based on its association with the cultural practices, traditions, beliefs, lifeways, arts, crafts, or social institutions of a living community.

Tribal consultation. Timely, meaningful, and substantive dialogue between Forest Service officials who have delegated authority to consult, and the official leadership of federally recognized tribes, or their designated representatives, pertaining to USDA Forest Service policies that may have tribal implications.

Off-highway vehicle. Motor vehicle capable of driving on and off paved or gravel surface, including all-terrain vehicles (ATVs), utility task vehicles (UTVs), and motorcycles.

Unauthorized road or trail. Road or trail that is not a National Forest System road or trail, temporary road, or temporary trail (36 CFR 212.1).

Unneeded road. Roads determined to not be needed for the long-term management of national forest resources, as determined by an appropriate planning document. Unneeded roads are closed to public, administrative, and permitted use. After it is determined that a road is no longer needed, vegetative cover should be reestablished on the road by either artificial or natural means per the Forest and Rangeland Renewable Resources Planning Act (16 U.S.C. 1608).

Ungulate. Hooved animal, which includes wildlife (e.g., pronghorn, deer, and elk) and domestic livestock (e. g., sheep, cattle, and horses).

Upland. May refer to areas, species, systems, or conditions that are characteristic of terrestrial ecosystems, as opposed to riparian or aquatic ecosystems.

Vegetation structure. Both vertical and horizontal arrangement of vegetation. Horizontal structure may refer tree size, tree density, and to patterns of trees or groups of trees and their adjoining openings. Vertical structure may refer to the layers, appearance, and composition of vegetation between the ground and the top of the vegetation canopy and includes any grasses, forbs, shrubs, and trees.

Watershed. Region or land area drained by a single stream, river, or drainage network; a drainage basin (36 CFR 219.19). Specifically, a HUC 10 hydrologic unit, larger than a subwatershed, and nested in a subbasin. See hydrologic unit code definition.

Watershed condition. The state of a watershed based on physical and biogeochemical characteristics and processes (36 CFR 219.19).

Wetlands. Specific subtype within the Wetland Riparian group of vegetation communities. In wetlands, saturation with water is the dominant factor determining the nature of soil development and plant and animal communities. “For regulatory purposes under the Clean Water Act, the term wetlands means ‘those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas’ [taken from the Environmental Protection Agency regulations listed at 40 CFR 230.3(t)].” (US EPA 2015) The Wetland Riparian vegetation community as defined in this plan is slightly more inclusive and includes open water wetlands and cienegas that may not be considered wetlands for regulatory purposes.

Wild and Scenic River. River designated by Congress as part of the National Wild and Scenic Rivers System that was established in the Wild and Scenic Rivers Act of 1968 (16 U.S.C. 1271 (note), 1271–1287) (36 CFR 219.19).

Wilderness. Any area of land designated by Congress as part of the National Wilderness Preservation System that was established in the Wilderness Act of 1964 (16 U.S.C. 1131–1136) (36 CFR 219.19).

Wildland-urban interface (WUI). That area where human development adjoins public or private natural areas, or an intermix of rural and urban land uses. From a natural resource perspective, the wildland-urban interface is an area where increased human influence and land-use conversion are changing natural resource goods, services, and management techniques (Hermansen-Baez et al. 2009).

Woodland. Lands with over 10 percent tree canopy cover where the majority of the trees are non-timber species (e.g., piñon pine and juniper) not traditionally used for industrial wood products.

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