United States Department of Agriculture

Forest Service

Rio Grande National Forest Plan Revision

Draft Environmental Impact Statement

Alamosa, Archuleta, Conejos, Hinsdale, Mineral, Rio Grande, Saguache, and San Juan Counties, Colorado

September 2017

Crestone Peak viewed through the Natural Arch

Acronyms and Abbreviations

ACS – American community survey
CCF – One hundred cubic feet
CERCLA – Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR – Code of Federal Regulations
DAU – Data analysis unit
DBH – Diameter at breast height
FY – Fiscal year
ForCaMF – Forest Carbon Management Framework
FSH – Forest Service Handbook
GDP – Gross domestic product
GMU – Game management unit
HUC – Hydrologic unit code
MA – Management area
MCF –Thousand cubic feet of timber
MMBF – Thousand thousand board feet of timber (i.e., million board feet of timber)
PILT – Payment in lieu of taxes
SCC – Species of conservation concern
SRS – Secure rural schools
TEPC species – Threatened, endangered, proposed, and candidate species
USDA – United States Department of Agriculture

Rio Grande National Forest Plan Revision Draft Environmental Impact Statement

Alamosa, Archuleta, Conejos, Hinsdale, Mineral, Rio Grande, Saguache, and San Juan Counties, Colorado

Lead agency:	**USDA Forest Service**
Cooperating agencies	**Bureau of Land Management** **Colorado Department of Natural Resources** **Colorado Division of Water Resources** **Colorado State Land Board** **Colorado Parks and Wildlife** **Colorado Water Conservation Board** **Navajo Nation** **Alamosa County** **Conejos County** **Hinsdale County** **Mineral County** **Rio Grande County** **Saguache County**
Responsible official:	**Dan Dallas, Forest Supervisor** 1803 W. Highway 160 Monte Vista, CO 81144
For more information, contact:	**Erin Minks, Forest Planner** 1803 W. Highway 160 Monte Vista, CO 81144 719-852-5941

Abstract: This draft environmental impact statement documents the analysis of four alternatives (A through D) developed by the Forest Service to revise the 1996 land and resource management plan, as amended, for the Rio Grande National Forest.

Send comments to:	**Rio Grande National Forest** **Attn: Rio Grande Forest Plan Revision** **1803 W. Highway 160** **Monte Vista, CO 81144** **rgnf_forest_plan@fs.fed.us**
Date comments must be received:	Within 90 days following publication of the notice of availability of the draft environmental impact statement in the Federal Register. The notice is expected to be published on or around September 15, 2017; however, it is the commenter's responsibility to calculate the end of the 90-day period.

Summary

Proposed Action

The Rio Grande National Forest proposes to revise its Land and Resource Management Plan (USDA Forest Service 1996), referred to as the "forest plan," in compliance with the 2012 Planning Rule (36 CFR § 219.17(3)(b)(1)). The area affected by the proposal includes about 1.8 million acres of public land in southcentral Colorado (Figure 1).

Purpose and Need

The purpose and need for revising the forest plan is the changed ecological, social, and economic conditions in the plan area that have occurred since the current forest plan was approved in 1996. These changes include the spruce beetle infestation, closure of mills and timber-related infrastructure in southwest Colorado, changes in communications technology, increased development along the Forest boundary, and the need to shift fire management direction focused on suppression to use fire for resource benefit.

Compliance with the 2012 Planning Rule drove additional needs for change related to species of conservation concern, identification of key ecosystem characteristics, ecosystem and habitat connectivity, inventory and evaluation of wilderness, and a re-evaluation of areas for wilderness and wild, scenic, and recreational rivers designation.

Public Involvement

The *notice of intent* to initiate the assessment phase was published in the Federal Register on December 26, 2014. From February 2015 through March of 2016, more than 50 meetings were held with partner organizations with more than 500 people attending. Concurrently, the Forest used a web-based tool to ask questions to inform the assessments. Public engagement was summarized in meeting notes, made available on the Forest's website, and later synthesized into 15 topic-based report packages composed of executive summaries, reports, and appendices. The executive summaries were explicitly designed to reach the broadest audience, with a summary of the resource issues and a synthesis of what was heard from the public.

The assessments were completed and a draft *need for change* document was published in March 2016. More than 100 people attended one of the three public meetings and a webinar. In response to public comments, the Forest completed two iterations of the need for change document before formalizing a *proposed action* and initiating *scoping*. A second round of public meetings in July 2016 included a proposed adaptive management framework and the use of optional plan content.

In June 2016, the Forest held two draft wilderness inventory meetings to refine criteria used in the wilderness inventory phase. In July, a final wilderness inventory report and draft evaluation report were published as well as an initial inventory of wild, scenic, and recreational rivers to be analyzed. The July meetings mentioned above also presented these two topics.

Comments collected were used to finalize the proposed action, which was published in the Federal Register on September 12, 2016. The proposed action included a draft plan, as well as a letter from the regional forester identifying a preliminary list of *species of conservation concern* for the Forest. The public comment period lasted 45 days from publication of the notice of intent, until about the end of October 2016. About 75 people attended the three public meetings held in late September.

Revision Topics

Each emphasis area identified in the need for change was considered as a potential revision topic. The March 2016 need for change document organized topics into tables that included items that are required to be addressed in revision, overarching changes to the forest plan identified through assessments, public comments, tribal consultation, or internal comments, and changes that are made at the discretion of the responsible official. The need for change was narrowed to four revision topics that vary by alternative and are used to compare and contrast the differences among alternatives.

The following revision topics were identified that drove alternative development:

- Special designations
- Fire management
- Management area complexity
- Recommended wilderness

Alternatives

Alternatives to the proposed action were developed in response to public comments and revision topics. All alternatives incorporate higher level direction, including laws, regulations and policies, as well as programmatic direction such as the Southern Rockies Lynx Amendment and the Colorado Roadless Rule.

Alternative A is the no-action alternative. This alternative reflects current management practices under the Rio Grande National Forest 1996 Revised Land and Resource Management Plan, as amended and implemented, and provides the basis for comparing alternatives to current management and levels of output. This alternative proposes 17 management areas.

Alternative B is based on a strategic framework that considers direction at a broad landscape level, or geographic area, and at a smaller, management area level. The overall vision for managing the Forest is encompassed in three overarching goals that address water quality and quantity, ecosystem resilience and sustainability, and economics and services provided through public land management.

Alternative B emphasizes multiple use that is similar to current management but is compliant with the direction contained in the 2012 Planning Rule. This alternative proposes an estimated 59,000 acres recommended for inclusion in the wilderness preservation system. Direction in one special interest area is reduced and boundary adjustments are proposed for two other areas. This alternative proposes 14 separate management areas.

Alternative C proposes to increase the acreage available for multiple uses on the Forest. No recommended wilderness acres are included in this alternative. This alternative addresses concerns about complexity by reducing the number of management areas to eight and shifts the boundaries to make them similar to the geographic area boundaries in alternative B. These larger units of land provide more flexibility in implementation of the forest plan by allowing habitat and areas to be mapped dependent on actual presence versus providing a static management area boundary. Alternative C includes more acreage in the suitable timber base and does not include any recommended wilderness.

Alternative D emphasizes recreation opportunities that provide more solitude and primitive recreation experiences. This alternative increases opportunities for semiprimitive, nonmotorized recreation, increases the number of special interest areas, proposes adding one new research natural area, and proposes approximately 285,000 acres of recommended wilderness. This alternative also identifies fewer acres suitable for timber production. Alternative D proposes 16 individual management areas.

Decision Framework

The responsible official for the analysis is the forest supervisor for the Rio Grande National Forest. The responsible official will prepare a final environmental impact statement based on the analysis and subsequent public comments, and will identify a selected alternative in a draft record of decision that will be subject to an objection process guided by the direction in 36 CFR Subpart B (219.50 to 219.62). The decision will:

- Establish desired conditions and objectives,
- Establish Forestwide design criteria (standards and guidelines),
- Establish management areas and geographic areas,
- Determine suitability of land,
- Determine the maximum amount of timber that might be removed,
- Recommend areas for inclusion in the National Wilderness Preservation System (36 CFR 219.7(c)(2)(v)) if applicable, and
- Identify suitable and eligible wild, scenic, and recreational rivers (36 CFR 219.7(c) (2) (vi)) if applicable.

A final record of decision and accompanying forest plan sets a course of action for managing the Forest for the next 10 to 15 years. Forest plans are strategic in nature and do not compel the Agency to undertake any site-specific projects.

The authorization of project-level activities is based on the direction contained in the forest plan, but occurs through subsequent project-specific environmental analysis in compliance with the National Environmental Policy Act.

Contents

List of Tables

List of Figures

List of Maps

All maps are contained on the DVD located at the back of this document.

Chapter 1. Purpose and Need for Action

Document Structure

This environmental impact statement is prepared in compliance with the National Environmental Policy Act and other relevant Federal and State laws and regulations. This document discloses the direct, indirect, and cumulative environmental impacts that would result from the proposed action and alternatives. The document is organized into four chapters:

- *Chapter 1. Purpose and Need for Action:* This chapter includes information on the history of the project proposal, the purpose and need for the project, and the Forest Service's proposal for achieving that purpose and need. This chapter also details how the Forest Service informed the public of the proposal and how the public responded.
- *Chapter 2. Alternatives, including the Proposed Action:* This chapter provides a more detailed description of the Forest Service's proposed action as well as alternative methods for achieving the stated purpose. These alternatives were developed on the basis of issues and comments raised by the public and other agencies. This discussion also includes any mitigation measures associated with the proposed action or alternatives. Finally, this section provides a summary table of the environmental consequences associated with each alternative.
- *Chapter 3. Affected Environment and Environmental Consequences:* This chapter describes the environmental effects of implementing the proposed action and other alternatives. It describes the affected environment, by resource area, as a baseline against which the impacts of alternatives are measured. The description of each resource or management focus is followed by disclosure of the potential indirect, and cumulative, effects of implementing the proposed action and each of the alternatives on that particular resource. Given the programmatic nature of this analysis, there are no direct effects of implementing the proposed action. Such effects would occur at the project level.
- *Chapter 4. Consultation and Coordination:* This chapter provides a list of preparers and agencies, government officials, and selected other parties who were consulted during the development of the document.
- *References*. This section reports full citations for the sources cited in the text.
- *Glossary*. The glossary defines terms used in this draft environmental impact statement.
- *Appendices*. The appendices provide more detailed information to support the analyses presented in the analysis.

Additional documentation, including more detailed analyses of project area resources, is contained in the project record, which is available at the Rio Grande National Forest Supervisor's Office, 1803 W. Highway 160, Monte Vista, Colorado, 81144. The office is located on the west side of Monte Vista, on the north side of Highway 160. Office hours are 8:00 am – 4:30 pm, Monday through Friday.

In this document, "forest" with a lower case "f" refers to areas with trees, while "Forest" or "Forestwide" with an upper case "F" refers to the Rio Grande National Forest. Forest Service land management plans are commonly referred to as forest plans. The proposed action is also sometimes called the proposed plan or draft plan, and it is being concurrently published with the formal title “Rio Grande National Forest Draft Revised Land Management Plan.”

Regulatory Direction

The National Forest Management Act of 1976 (Public Law 94-588) directs the Forest Service to develop land management plans (forest plans), which direct the management of the natural resources and human uses of each national forest. Implementation of the National Forest Management Act (36 CFR 219) requires every national forest to revise its land management 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 evaluation of monitoring data indicates that a revision is necessary.

Many forest plans have not been revised on schedule for various reasons, but an important factor includes the time and capacity needed to produce a forest plan amendment, which can take 3 to 5 years to complete. Since the Rio Grande Forest Plan was last revised in 1996, the plan has required seven amendments, including several project-specific amendments as well as amendment of Forestwide direction, such as the Management Indicator Species Amendment (2003) and the Southern Rockies Lynx Amendment (2008).

Many other laws and regulations apply to management of the national forests including, but not limited to, the Clean Air Act, Clean Water Act, Endangered Species Act, and National Historic Preservation Act. Issues that do not warrant citation of the direction contained in the law or regulation are generally not repeated or referenced in a forest plan. Additional direction and policy for managing national forests are provided in Executive orders, the Code of Federal Regulations, and the Forest Service directives system. The Forest Service directives systems includes Agency-specific manuals and handbooks that contain information that is not repeated in a forest plan.

2012 Planning Rule Direction

Issued by the U.S. Department of Agriculture, the new 2012 Planning Rule emphasizes that forest plans are to guide forest management so that national forests are ecologically sustainable and contribute to social and economic sustainability. National forests are managed to provide ecosystems and watersheds with ecological integrity and diverse plant and animal communities. In addition, they are managed to have the capacity to provide people and communities with ecosystem services and multiple uses that provide a range of social, economic, and ecological benefits for the present and into the future.

Three phases of planning are described in the 2012 Planning Rule:

- Assessment,
- Development, amendment, or revision of forest plans, and
- Monitoring. (See 2012 Planning Rule at 36 CFR 219.6, 219.7, 219.12, and 219.13.)

The Rio Grande forest plan was signed in 1996, and the direction contained was still applicable and valid. However, the recent spruce beetle infestation caused a change in condition that warranted revision of the existing forest plan. The Rio Grande is the first national forest in the Rocky Mountain Region to undergo revision under the 2012 Planning Rule. The Forest began the assessment phase of planning in 2014. Through the assessments and extensive public involvement, the Forest began the revision process in 2016 by developing and releasing a need for change, strategic framework, and proposed action. This environmental impact statement analyzes the alternatives that have been developed and presents an adaptive management process and monitoring plan that will be implemented upon completion of the forest plan revision process.

Forest Plan Content

Forest plans provide a framework for integrated resource management and for guiding project and activity decision-making. Plans themselves do not compel any action, authorize projects or activities, or guarantee specific results. Instead, they provide the vision and strategic direction needed to move the national forest toward ecological, social, and economic sustainability. Proposed draft revised plans include “plan components” and “other content.”

After a plan is approved, any substantive changes to *plan components* require a plan amendment. Revisions to *other plan content* to correct nonsubstantive content (such as misspellings or typographical mistakes), or to update information (such as data and maps), may be made using an administrative correction process. The public is notified of all plan amendments and administrative corrections before they become effective.

Plan Components

A forest plan provides general strategic framework to guide national forest staff as they propose, analyze, and decide on projects and activities. The five required components of a forest plan include desired conditions, objectives, standards, guidelines, and suitability of lands. A plan may also include goals as an optional component.

- A **desired condition** describes the specific social, economic, or ecological characteristics of the plan area, or a portion of the plan area, toward which management of the land and resources should be directed. This description is specific enough to allow assessment of progress toward achievement but does not include a completion date.
- An **objective** is a concise, measurable, and time-specific statement of a desired rate of progress toward one or more desired conditions. Objectives are based on reasonable foreseeable budgets.
- A **standard** is a mandatory constraint on project and activity decision-making, established to help achieve or maintain the desired condition, to avoid or mitigate undesirable effects, or to meet applicable legal requirements.
- A **guideline** is a constraint on project and activity decision-making that allows for departure from its terms (more flexibility), as long as the purpose of the guideline is met. Guidelines are established to help achieve or maintain the desired condition or

conditions, to avoid or mitigate undesirable effects, or to meet applicable legal requirements.

- **Suitability** of lands is determined for specific lands within the plan area. The lands are identified as suitable or not suitable for various uses or activities based on desired conditions applicable to those lands. The suitability of lands is not identified for every use or activity. Identification of certain lands as suitable for a use is not a commitment to allow such use, but only an indication that the use might be appropriate. If a plan identifies certain lands as not suitable for a use, then that use or activity may not be authorized unless a change in the plan is made.

Optional Plan Components

- A **goal** describes a broad statement of intent. These are overarching desires for management of the national forest within the 2012 Planning Rule framework that do not include completion dates.

Other Plan Content

Other content included in forest plans includes background information, general area descriptions, identification of priority watersheds for maintenance and restoration, and management approaches—which describe the principal strategies and program priorities that each national forest intends to employ to carry out projects and activities under the plan. Potential management approaches may discuss potential processes such as analysis, assessment, inventory, project planning, or project monitoring. They can convey a sense of priority and focus along with a likely management emphasis. Management approaches relate to desired conditions.

The monitoring program is based on the practice of adaptive management, which is recognized as critical for managing natural resources. The purpose of monitoring in an adaptive management framework is to facilitate learning to support determinations on whether changes to the forest plan are needed.

Additionally, the forest plan includes implementation direction for a public adaptive management process that will be implemented to increase public involvement in plan-level decision-making.

Background of the Forest

The Rio Grande National Forest consists of about 1.83 million acres in south-central Colorado (Figure 1) and forms the backdrop for the San Luis Valley, one of the largest mountain basins in the world. The headwaters of the Rio Grande originate within the Forest boundary, and most watersheds on the Forest feed into the Rio Grande system. Water for municipal, industrial, and agricultural purposes comes from the Sangre de Cristo mountain range on the east side of the valley, and the San Juan mountain range to the west. The Forest was established in large part for the protection of these watersheds, and this foundational language is every bit as relevant today as it was at the inception of the original forest reserve as described later in the *Administrative History* section.

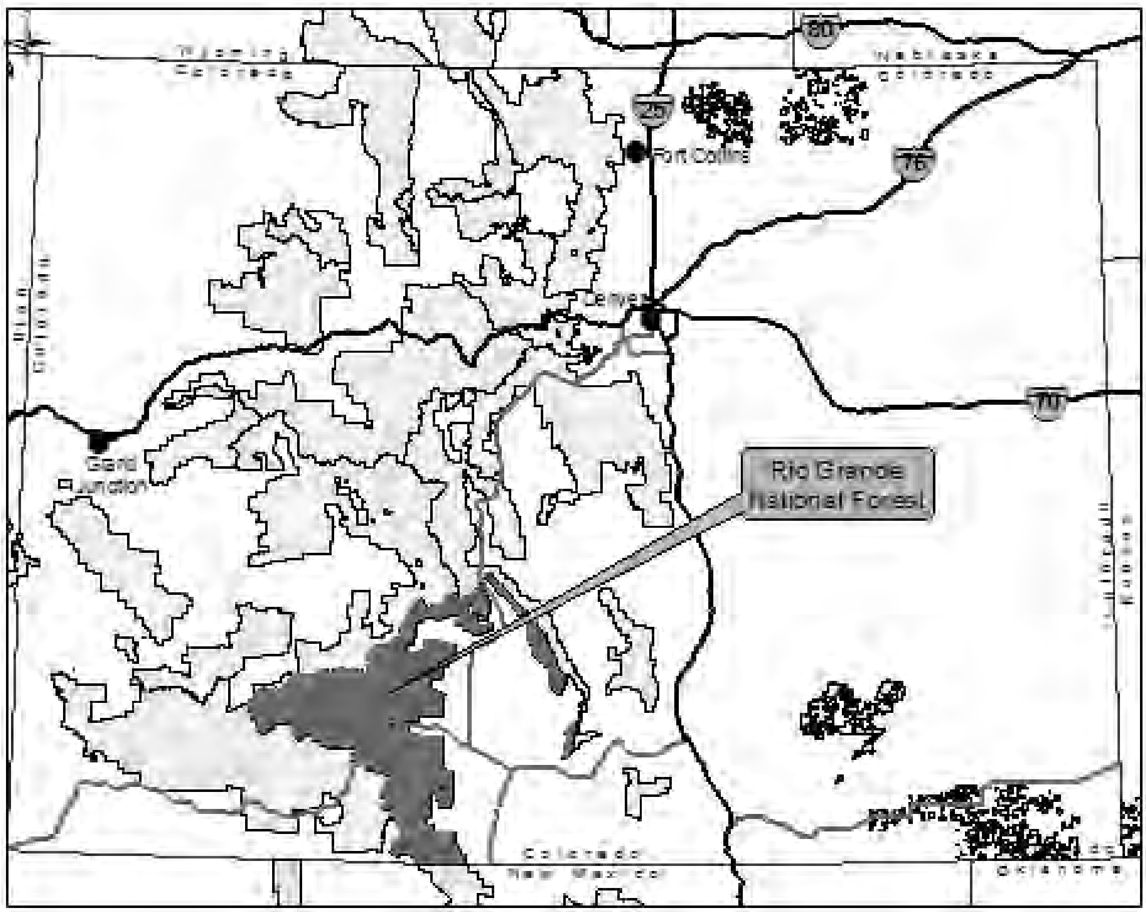


Figure 1. Location of Rio Grande National Forest in Colorado

The Forest is administered by the U.S. Department of Agriculture Forest Service, which is one of several land management agencies in the San Luis Valley. Department of Interior agencies that management land in the valley include the Bureau of Land Management, National Park Service, and U.S. Fish and Wildlife Service. All of the agencies have similar missions and directives and work collaboratively across area boundaries. Differences among the agencies are typically not understood by the general public. A map showing *Land Ownership* is contained on the DVD located at the back of this document.

State agencies also provide input to management on Federal lands. For example, Forest staff collaborate closely with Colorado Parks and Wildlife staff in the management of habitat for wildlife species, including big game species such as elk and bighorn sheep. Colorado Parks and Wildlife directs herd location and management that relates to the habitat management responsibilities of the Forest.

Elevation ranges from about 7,800 feet in the foothills to more than 13,000 feet in the San Juan Mountains along the Continental Divide. A few Sangre de Cristo elevations, to the east, exceed 14,000 feet.

The expansive and flat San Luis Valley, which contains very little National Forest System land, is composed of unconsolidated sediments laid down during the late Tertiary period. The Sangre de Cristo and San Juan mountain ranges on either side of the San Luis Valley, where most of the Forest is located, are of different origin and geologic age. The San Juan Mountains are composed of volcanic rocks and related shallow, intrusive rocks of the mid- to late-Tertiary period. Although the Sangre de Cristo Mountains are of more recent origin, the bedrock is older. The steep, narrow Sangre de Cristo Mountains were formed by faulting and thrusting along the Rio Grande Rift, a north-trending continental rift zone that separates the Colorado Plateau to the west from the Southern Rocky Mountains to the east.

Forest ecosystems generally vary by elevation, with the highest elevation containing the alpine tundra that occurs at or above 11,500 feet. Decreasing in elevation is the spruce-fir forest, which is generally inhabited by Engelmann spruce and subalpine fir mixed with quaking aspen. Vegetation in these ecosystems has been substantially altered by the recent spruce bark beetle infestation.

The Rocky Mountain alpine turf ecosystem is widespread above the upper timberline (11,000 feet and higher). Dominant species include boreal sagebrush, several sedge species, tufted hair grass, fescue grasses, Ross' avens, Bellardi bog sedge, cushion phlox, and alpine clover.

The mixed conifer-wet ecosystem occurs in the transition zone between the higher elevation spruce-fir and the drier mixed conifer type. It is generally dominated by Douglas fir and various combinations of white fir, Colorado blue spruce, Engelmann spruce, or subalpine fir, with incidental occurrences of ponderosa pine.

The drier mixed conifer ecosystem sites include a mix of conifer species, including ponderosa pine, Douglas fir, white fir, Colorado blue spruce, and smaller amounts of aspen. Depending on site conditions, limber pine, bristlecone pine, and some pinyon pine or juniper can be present.

Closer to the valley the pinyon-juniper woodland ecosystem includes pinyon pine, Rocky Mountain juniper, and Utah juniper. These woodlands generally occur on warm, dry sites on mountain slopes, mesas, plateaus, and ridges. Understory species include sparse perennial grasses, annual and perennial forbs, and sparse shrubs.

Rocky Mountain Gambel oak shrubland ecosystems are present at the north end of the San Luis Valley near Poncha Pass. Dominant species include Gambel oak, serviceberry, sagebrush, and various other shrubs, grasses, and forbs.

The Southern Rocky Mountain montane-subalpine grassland ecosystem includes Thurber fescue, Arizona fescue, and several other grasses, forbs, and sedges.

The Rocky Mountain riparian ecosystem includes numerous riparian types in the upper montane/subalpine zones. These systems are highly variable and generally consist of cottonwoods, willows, sedges, other herbaceous vegetation, aspen, and conifers such as blue spruce, Engelmann spruce, and subalpine fir.

The Rio Grande National Forest provides habitat for an estimated 300 species of mammals, birds, reptiles, amphibians, and fish. Eight of the 300 species are federally recognized as threatened or endangered animal species:

- Black-footed ferret
- Canada lynx
- Gunnison sage-grouse
- Mexican spotted owl
- New Mexico meadow jumping mouse
- Southwestern willow flycatcher
- Uncompahgre fritillary butterfly
- Yellow-billed cuckoo

The Rio Grande National Forest represents a large part of the core area for Canada lynx, which were reintroduced to Colorado during 1999–2006. The vast majority of Canada lynx in Colorado remain and reproduce in the high-elevation spruce-fir zone in the southwestern part of the state, including on the Forest.

Counties containing National Forest System lands include Alamosa, Archuleta, Conejos, Hinsdale, Mineral, Rio Grande, Saguache, and San Juan. Many counties are characterized by low population densities, high unemployment, and low per capita income. Although there are no National Forest System lands in Custer and Costilla Counties, people there rely on the Forest for gathering forest products such as firewood, and for hiking, camping, and other recreational activities.

The area of influence for the Forest extends beyond the eight counties that contain lands within its boundaries. Colorado communities within Alamosa, Archuleta, Chafee, Conejos, Costilla, Custer, Fremont, Gunnison, Hinsdale, La Plata, Mineral, Montrose, Park, Rio Grande, Saguache, and San Juan Counties and New Mexico communities in Rio Arriba and Taos Counties are recognized as having strong socio-economic ties to the Forest. These 16 counties are included in the area of economic influence

Communities surrounding the Forest have become increasingly attractive to new residents because of their proximity to open spaces, natural settings, and easy access to year-round recreational opportunities. Population projections indicate that the San Luis Valley and the region surrounding the Forest will continue to grow, increasing demands on Forest resources.

The Forest offers diverse recreation opportunities that include backpacking, boating, camping (both developed and dispersed), cross-country skiing, fishing, hiking, hunting, off-road vehicle riding, picnicking, rock climbing, snowshoeing, and snowmobiling.

More than 1,350 miles of trails traverse the Forest, including the Continental Divide National Scenic Trail, the Colorado Trail, and the Old Spanish National Historic Trail. About 170 miles of the Continental Divide National Scenic Trail traverse the Rio Grande National Forest, starting at the boundary with the Gunnison National Forest and stretching to the New Mexico state line. Sections of the Old Spanish National Historic Trail, designated in 2002, pass through the Rio Grande National Forest, offering a glimpse into past trade routes along which supplies and slaves were moved from Santa Fe to the California Territory in the 1820s.

Colorado has the sixth-highest acreage of National Forest System lands nationwide, with about 14,471,800 acres of national forests and grasslands that provide places for recreational activities for residents and tourists. For Colorado and most of the Rocky Mountains, tourism is a main source of income. There is a direct tie between the beautiful scenery provided by the Forest and local economic benefits.

The Rio Grande National Forest makes up 13 percent of the National Forest System land in the State of Colorado. Traversing the Forest are two designated scenic byways—the Silver Thread and Los Caminos Antiguos (Colorado Department of Transportation 2017)—and a well-developed system of roads and trails. Many outfitter and guide services provide visitor opportunities to experience the Forest.

Located in the south-central part of the Rocky Mountain range, the Forest offers unique scenic experiences. Southwestern flora combine with the spectacular scenery of the central Rocky Mountains. To the east, the open floor of the San Luis Valley is surrounded by the rugged mountain peaks of the Sangre de Cristo range. To the north, high mountain peaks give way to gentler rolling hills covered in lodgepole pine that extend to the valley bottom. Looking west, the scattered mountain peaks are mixed with rolling hills, rock canyons, and open meadows. To the south the valley is fairly flat, with several dominant, rounded mountains that rise above the horizon.

These characteristics offer visitors some of Colorado's most beautiful scenery. The Sangre de Cristo range is home to several of Colorado's 14,000-foot peaks including Crestone Peak, Crestone Needles, Kit Carson, and Blanca Peak. Great Sand Dunes National Park and Preserve borders the Forest in the Sangre de Cristo range. Some of the tallest dunes in North America occur in the park, which is managed by the National Park Service and is adjacent to the Forest.

The western part of the Forest has a view of the Rio Grande Pyramid, the 100-foot-high North Clear Creek Falls, Bristol Head Mountain, the headwaters of the Rio Grande river system, and the La Garita, South San Juan, and Weminuche Wilderness areas. Parks and open meadows, such as Saguache Park, contain a variety of plant and animal life and are home to a wide range of wildflowers.

Historic scenic areas include the Bachelor Loop, near Creede; the Bonanza Loop, near Villa Grove; and the Cumbres & Toltec Scenic Railroad, near Antonito. Tucked in the foothills are many unique rock formations, including the Natural Arch and Summer Coon Volcano areas. Adjacent Bureau of Land Management lands have well-known rock climbing areas such as Penitente, Witches, and Sidewinder Canyons, and the Rock Garden, that draw avid rock climbers to the area.

Administrative History

The Rio Grande National Forest was established by President Theodore Roosevelt on July 1, 1908. The proclamation language created the Forest "from those parts of the San Juan and Cochetopah National Forests within the Rio Grande river drainage, excluding the land containing Saguache Creek, Carnero Creek and their tributaries, and the tributaries of San Luis Creek."

Although the Forest Reserve Act was passed in 1891, reserves that later would become the Rio Grande National Forest were not created until April 11, 1902, when the San Isabel Forest Reserve was created by Theodore Roosevelt, including a portion of the Sangre de Cristo mountain range from Poncha Pass to Mt. Blanca. The reserve was created in response to a petition by the San Luis Valley Cattlemen, among others, to protect the watershed for the growing San Luis Valley agricultural economy (Godfrey 2012).

On June 3, 1905, the San Juan Forest Reserve was established, including lands south and west of the Rio Grande from the headwaters to the New Mexico state line. The San Juan was created following a field report generated by Coert DuBois in 1903. The field report documented characteristics of the lands that would become the Reserve including topography, climate and precipitation, prevailing winds, and vegetation types at various elevations. The DuBois report also documented the human activities impacting the forest at the turn of the century, including "farming, sheep and cattle raising, lumbering and mining, named in the order of their importance." Ultimately, the report recommended creation of the San Juan Forest Reserve with a priority on watershed health, specifically "to prevent spring floods and summer droughts; ensure a steady supply of timber for developing the area's mineral resources and to prevent control of timber supply from passing into the hands of large lumber companies; to prevent overstocking of the range; and to prevent and control repeated forest fires" (Godfrey 2012). The first headquarters was located in Durango in 1906 and was shared with the newly established Montezuma Forest Reserve. Later that year, the supervisor's office for the San Juan Forest Reserve was moved to Monte Vista. Early ranger districts on the Rio Grande side of the reserve were the Pyramid, Creede, Alamosa, and Conejos.

Ten days following the creation of the San Juan Forest Reserve, the Cochetopah Forest Reserve was created on June 13, 1905. This Reserve included lands that would become the northwest portion of the Rio Grande National Forest, extending from the north side of the Rio Grande headwaters system north through the Cochetopa hills to the west side of Poncha Pass. The Cochetopah was recommended following another field report generated by John Hatton, which recommended creation of the Reserve to ensure protection of the watershed for downstream irrigation. The Cochetopah became its own national forest in 1907 when all reserves became national forests. Original ranger districts that later became part of the Rio Grande National Forest include the Saguache and Poncha Districts, with guard stations at Stone Cellar, Upper Crossing, and Brewery Creek, and a ranger station in Saguache. The Poncha District abutted the San Luis Ranger District of the San Isabel National Forest, with an office in Moffat.

After the original formation of the Rio Grande National Forest in 1908, it remained one of three national forests managing the Rio Grande headwaters until the 1940s. After being created out of the San Juan Forest Reserve, the new national forest retained the previous ranger districts of Pyramid, Creede, Alamosa, and Conejos and created the South Fork District with a ranger station on Alder Creek. In 1920, the Del Norte Ranger District was carved out of portions of the Alamosa and Alder/South Fork Districts. In 1940, the boundaries of the Del Norte District were slightly changed and while the district remained, the Alamosa Ranger District was restored. Finally, the Pyramid and Creede Districts were consolidated into the Creede Ranger District, which continued to use the ranger station in Creede.

President Franklin Roosevelt transferred portions of the Cochetopah National Forest to the Rio Grande National Forest on December 29, 1938. Then, in late 1943, following recommendations in 1940 under the authority of the General Exchange Act of 1922 to acquire certain lands of the Tierra Amarilla Land Grant, a title to those lands owned by the

Hughes Estate and known as Chama Basin was transferred to the Forest. On January 17, 1945, the Cochetopah National Forest was abolished and its ranger districts placed under the administration of the Gunnison (Tomichi), Rio Grande (Saguache) and San Isabel (Buena Vista, Leadville, and major portions of Poncha) National Forests. The transfer was retroactively effective as of July 1, 1944. The remaining portions of the west flank of the Sangre de Cristo Mountains were transferred from the San Isabel National Forest to the Rio Grande National Forest on October 26, 1954.

Purpose and Need for Action – The Need for Change and Revision Topics

This document analyzes a suite of alternatives that will ultimately revise the existing land management plan for the Rio Grande National Forest. The purpose and need for this action is primarily the age of the current plan and a significant changed condition on the Forest. The current forest plan is 20 years old and has been amended seven times. Since the forest plan was approved in 1996, significant changes in economic, social, and ecological conditions in the plan area have taken place, including the infestation of about 610,000 acres of spruce trees by the spruce beetle (USDA Forest Service GSC 2016).

The purpose and need for revising the current plan is also to incorporate new policies, priorities, information from monitoring reports, and scientific research as required under the 2012 Planning Rule. Forest staff have completed monitoring reports annually from 1997 through 2013. The 2012 Planning Rule, which became effective May 9, 2012, requires inclusion of plan components that address social and economic sustainability, ecosystem services, and multiple uses integrated with the plan components for ecological sustainability and species diversity. Social and economic management direction is needed to provide people and communities with a range of social and economic benefits for present and future generations. To meet the 2012 Planning Rule requirement to provide for ecological sustainability, management direction is also needed that addresses ecosystem integrity and diversity, including key ecosystem characteristics, in light of changes in climate, landownership, and recreational use patterns, as well as other threats and stressors to those ecosystems.

Revised plan components that focus on maintaining or restoring aquatic and terrestrial ecosystems are needed to provide for species diversity, including threatened and endangered species, and species of conservation concern. Additionally, updates and modifications to management direction are needed to address suitability of certain areas for particular uses, address access and sustainable recreation, and provide for the management of existing and anticipated uses. The 2012 Planning Rule also requires the identification of areas suitable for timber harvest on the Forest, the re-evaluation of the maximum quantity of timber that may be removed from the Forest, a description of the proposed and possible actions related to the planned timber sale program, timber harvesting levels, and the proportion of various methods of forest vegetation management practices.

Most importantly, the purpose and need is to address the identified needs to change the existing plan that was presented to the public in March 2016 and refined into an initial proposal in July 2016. These needs for change were identified through the monitoring reports mentioned above, internal staff recommendations, and the assessment phase of the revision process, which was initiated in December 2014 and completed in March 2016. Extensive public and employee involvement, along with science-based evaluations, has helped identify these preliminary needs to change the existing forest plan. During the assessment phase alone, more than 50 public meetings were held in multiple forums to engage the public on the current condition and potential needs to change the management of the Forest. Upon completion of the assessment phase, two additional rounds of meetings were held on each district in March and July of 2016 to discuss and further refine the needs for change and initial proposal summarized in the proposed action items described below.

Listed below are the broad need for change topics for the revised forest plan, as described in the March 2016 need for change document and refined in the July 2016 initial proposal. These topics were distributed in the documents through tables A, B, and C, tiered to their legal requirements and levels of discretion at the Forest level. These are considered need for change topics because, by themselves, any change in management direction would generally result in a significant amendment of the forest plan because their resolution could change management direction over large areas of the Forest, the mix of goods and services that the Forest provides, and other decisions made in national forest planning. The listed topics can be thought of as an "umbrella" for several important issues related to the same revision topic, to be discussed in further detail later in this chapter.

- Terrestrial, riparian, and aquatic ecosystem integrity
- Habitat connectivity and viability of species of conservation concern
- Sustainable recreation opportunities and suitability of uses
- Wilderness, wild, scenic and recreational rivers, and other special designations considerations
- Timber suitability and management
- Risk management, climate change vulnerabilities, and renewable energy
- Social and economic sustainability and ecosystem services
- Prescribed and naturally occurring fire as a management tool

The need for change topics listed above are not the only changes addressed in the plan. Many other changes were raised as potential revision topics during the assessment phase but were not identified as needs for change. Those issues were listed in both the March and July need for change documents as "desired changes identified through the assessment phase" in Table D of the Purpose and Need for Action (USDA Forest Service 2016a). At the time, the deciding official believed that those changes might not be relevant, timely, or appropriate for further analysis. At least three changes originally contained in Table D were moved to Table C as an identified need for change following public comment and interdisciplinary team review, including consideration of the suitability of over-snow travel and communication sites, and additional management direction to ensure separation of domestic sheep and pack goats from bighorn sheep. There is also a need to integrate previous amendments and management decisions, including the Southern Rockies Lynx Amendment, Baca Mountain Tract Amendment, water rights settlement and decree in Colorado Case No. 81-CW-183 from March of 2000, and the Colorado Roadless Rule finalized in 2012.

Travel Management

Travel management addresses the use of motor vehicles on National Forest System lands. Many commenters confuse travel management with a determination of land suitability. While one process informs the other, the two are separate processes. The 2012 Planning Rule requires that the forest plan identify lands as suitable for various uses or activities based on the desired conditions for those lands. Suitability of lands in the plan area integrates social, economic, cultural, and ecological considerations. Identification of suitable lands is not required for every resource or activity or acre of land.

Travel management identifies which lands are available for all types of motorized vehicle use, which includes passenger vehicles, snow machines, motorcycles, four wheelers, etc. When designating uses, the responsible official considers the effects on natural and cultural resources, public safety, recreational opportunities, access needs, conflicts among uses of the lands, the need for maintenance and administration of roads, trails, and areas that would arise if the uses under consideration are designated, and the availability of resources for that maintenance and administration. The Travel Management Rule, Subpart (b), provides specific criteria for designation of trails and areas. The objective of the decision by the responsible official is to minimize: (1) damage to soil, watershed, vegetation, and other forest resources, (2) harassment of wildlife and significant disruption of wildlife habitats (Federal Register /Vol. 70, No. 216 /Wednesday, November 9, 2005 /Rules and Regulations).

The Forest has determined to complete the travel management process subsequent to the forest planning process. The forest plan process will identify what lands are suitable for motorized use based on desired conditions. The travel management process will then determine the effects of those uses on Forest resources and use and determine what roads, trails, and areas can accommodate motorized use. Completing the process in this manner allows determinations of suitability to be established and better inform the travel management process. The travel management plan approved with the 1996 forest plan will continue to be implemented until a separate revision process is initiated following revision of the forest plan.

Proposed Action

The Rio Grande National Forest is proposing to revise the forest plan to address the needs for change developed in March 2016. The Forest proposes to establish a strategic management framework to guide development of the forest plan direction and implementation for the next 10 to 15 years. The framework is designed to increase the responsiveness of forest managers to changing conditions on the landscape, including changes from higher level direction, and new technologies that are not yet foreseen. Developed with the public through the spring and summer of 2016, this framework includes an overarching geographic area layer that groups the management areas mostly contained in the 1996 forest plan. The geographic areas are tiered to levels of active management, the responsible official’s discretion in managing the specific areas, and the current legal status of the land. The framework provides an opportunity for the revised plan to better communicate how the Agency manages the Forest, which was a common theme heard throughout the public process.

The proposed action includes Forestwide goals, objectives, and desired conditions, as well as management area specific desired conditions. To ensure for management accountability, the

Forest is proposing standards, guidelines, and suitability determinations to reflect this adaptive management strategy while ensuring for ecosystem integrity, sustainability, habitat connectivity, and the viability of species of conservation concern.

The proposed action, which is alternative B, identifies watersheds that are a priority for maintenance and restoration as required in the 2012 Planning Rule. It also includes an estimate of what may be suitable timber acreage for the next 10 to 15 years, as well as a proposal for fire management zones. The Forest intends to re-evaluate the suitability of its National Forest System lands to support other multiple uses, including over-snow vehicle use, communication sites, and utility corridors.

When developing alternative B, the Forest conducted an analysis of changes to suitable and eligible wild, scenic, and recreational rives. Forest specialists analyzed 34 stream reaches as potentially suitable and eligible for inclusion in the National Wild and Scenic Rivers System. One segment of Deadman Creek in the Sangre de Cristo range is being carried forward into analysis of the potential outstanding resource values.

The Forest also conducted a process that conducted an inventory and evaluation of potential wilderness acres. This extensive process is documented in Rio Grande National Forest Draft Wilderness Evaluations (USDA Forest Service 2016c), which are available on the Forest website.

The proposed action describes a monitoring plan as part of the adaptive management framework to ensure accountability. The monitoring plan presents questions and indicators of measures to address eight topic areas required by the 2012 Planning Rule. The monitoring plan uses data from existing databases and ongoing partnerships as much as possible, including further development of a partnership with the State and Private Forestry Forest Inventory and Analysis program.

Alternative B proposes to establish an expectation of an annual information-sharing meeting with the public to gauge implementation of the forest plan and identify potential needs for changes and amendments to the forest plan. Depending on the level and extent of the necessary adjusments, there may be a need to complete a forest plan amendment or administrative change. Regardless of the process used, any changes to plan content would be conducted with public involvement.

The proposed action is formally known as the Rio Grande National Forest Draft Revised Land Management Plan, which is being published simultaneously along with this Rio Grande National Forest Plan Revsion Draft Environmental Impact Statement. *Maps of management areas and geographic areas for alternatives A through D* are contained on the DVD located at the back of this document.

Decision Framework

The responsible official for the analysis is the forest supervisor for the Rio Grande National Forest. The responsible official will prepare a final environmental impact statement based on the analysis and subsequent public comments, and will identify a selected alternative in a draft record of decision that will be subject to an objection process guided by the direction in 36 CFR Subpart B (219.50 to 219.62). The decision will:

- Establish desired conditions and objectives,
- Establish Forestwide design criteria (standards and guidelines),
- Establish management areas and geographic areas,
- Determine suitability of land,
- Determine the maximum amount of timber that might be removed,
- Recommend areas for inclusion in the National Wilderness Preservation System (36 CFR 219.7(c)(2)(v)) if applicable, and
- Identify suitable and eligible wild, scenic, and recreational rivers (36 CFR 219.7(c) (2) (vi)) if applicable.

A final record of decision and accompanying forest plan sets a course of action for managing the Forest for the next 10 to 15 years. Forest plans are strategic in nature and do not compel the Agency to undertake any site-specific projects. Project-level environmental analysis will be completed for specific proposals that implement direction in the forest plan.

The forest plan provides strategic direction and a framework for decision-making during the life of the plan, and does not repeat information already required or described in existing laws, regulations, or guidance. The forest plan does not make site-specific project decisions or dictate day-to-day administrative activities needed to carry on internal operations within the Forest Service. The authorization of project-level activities is based on the direction contained in the forest plan, but occurs through subsequent project-specific environmental analysis and decision-making as required by the National Environmental Policy Act. Though strategic guidance is provided, no decisions will be made regarding the management of individual roads or trails, such as those that might be associated with a travel management plan under 36 CFR Part 212. Some issues, although important, are beyond the authority or control of a forest plan and will not be addressed. For example, inventoried roadless area boundaries established by the Colorado Roadless Rule will not be modified.

Public Involvement

The Forest has engaged in collaboration and public involvement to inform revision of the forest plan since October 2014. Prior to the beginning of assessment development, the Forest hosted four community awareness meetings and interviewed key stakeholders to gauge awareness of forest planning and the best timing to hold assessment meetings.

The notice of intent to initiate the assessment phase was published in the Federal Register on December 26, 2014. From February 2015 through March 2016, more than 50 topic-based and co-hosted meetings were held with partner organizations. More than 500 people attended. Concurrently, the Forest used a web-based tool to ask questions to inform the assessments. Public engagement was first summarized in meeting notes that were made available on the website and later synthesized into 15 topic-based report packages composed of executive summaries, reports, and appendices. The executive summaries were explicitly designed to reach the broadest audience, with a summary of the resource issues and a synthesis of what was heard from the public. The executive summaries were generally less than five pages and used the headers “what we asked,” “what we heard,” and “where we’re headed.”

The assessments were completed and a draft need for change document was published in March 2016. More than 100 people attended one of the three public meetings and a webinar. In response to public comments, Forest staff committed to working through two iterations of the need for change document before formalizing a proposed action and initiating scoping. The second need for change document, or initial proposal, was presented through another round of public meetings in July 2016 and included a proposed adaptive management framework and the use of management practices, later renamed management approaches, as plan components.

In June 2016, the Forest held two draft wilderness inventory meetings to refine criteria used in the wilderness inventory phase. The Forest successfully presented a draft inventory map at both meetings. In July, a final wilderness inventory report and draft evaluation report was published as well as an initial inventory of wild, scenic, and recreational rivers to be analyzed. The July meetings mentioned above also presented these two topics.

Comments on the initial proposal were used to create the proposed action, which was published in the Federal Register on September 12, 2016. The proposed action included a draft plan, as well as a regional forester letter confirming the species of conservation concern for the Forest. Scoping lasted 45 days, until roughly the end of October 2016. About 75 people attended the three public meetings held in late September.

Overall, the Forest has benefitted from mostly positive feedback from the public leading up to scoping. Consistent leadership in key positions (forest supervisor, public affairs staff) has helped preserve a sense of trust, at least with the local public.

Collaboration

The Forest has maintained ongoing collaboration with counties, state agencies, and tribes, starting with stakeholder interviews conducted in October 2014, to develop the assessment phase strategy. During plan development, the Forest was able to further focus collaboration with counties and state agencies. A local stakeholder group applied for funds through Colorado's Federal Lands Coordination program to facilitate county engagement in federal land planning. These funds allowed the Forest to contract with Agnew: Beck to facilitate the plan development meetings. The Forest plan revision effort was the first time this program had been used in Colorado. The Forest also formalized a cooperating agency relationship with Alamosa, Conejos, Hinsdale, Rio Grande, Saguache, and Mineral Counties, Colorado's Department of Natural Resources, and the Navajo Nation in May 2016 and held focused meetings with this group in May and November 2016.

Tribal Consultation

In October 2014, the Forest initiated formal government-to-government tribal consultation by mail with 19 consulting tribes. Consultation began by offering tribes the opportunity to establish their level of involvement throughout the assessment and plan development processes. The San Luis Valley Native American Graves Protection and Repatriation Act Working Group already was in existence. Participants include the National Park Service, Bureau of Land Management, U.S. Fish and Wildlife Service, and 13 consulting tribes. Discussion at an October 2014 meeting included how the tribes might be involved in forest plan revision. Five tribes elected to participate in the assessment process.

Heritage staff met with the Jicarilla Apache Tribe, Navajo Nation, Santa Ana Pueblo, Southern Ute Tribe, and Ute Mountain Ute Tribe in 2015 to determine need for change topics and discuss features and areas of interest, including Blanca Peak, which was the focus of a May 2015 meeting to discuss the significance of the mountain and ways of unifying the federal ownerships across four agencies in its management. Attendees included representatives from the Navajo, Jicarilla, and Southern Ute, the Forest, Bureau of Land Management, U.S. Fish and Wildlife Service, and National Park Service.

In February 2016, the Navajo Nation became a cooperating agency in addition to their existing government-to-government relationship. In October 2016, the Forest updated the San Luis Valley Native American Graves Protection and Repatriation Act Working Group on the assessments, the wilderness recommendation process, and needs for change. In 2017, heritage program staff discussed management of oshá and draft plan components with tribes, including the Southern Ute Tribe. Staff also met with the Navajo Nation to further discuss proposed management strategies for Blanca Peak. Additionally the Forest sent a letter to the 19 consulting tribes formally requesting input on draft plan components related to areas of tribal importance.

Research Opportunities and Partnerships

During plan development, the Forest reached out to the Forest Service Rocky Mountain Research Station when developing management direction related to insects and disease, hydrology, drought, and other reasonably foreseeable climate trends within the life of the revised plan. Initial discussion culminated in a two-day workshop in October 2016 with Forest staff and researchers from Rocky Mountain Research Station to share research findings and strategize on plan direction related to the topics described above. Many of the research findings were used by the Forest Service to develop revised plan direction.

Partnership opportunities have been discussed throughout this revision effort to enhance public involvement at all levels of forest planning. Partnerships focused on management direction are detailed in the *Cultural Resources* and *Sustainable Recreation* sections of the plan. The monitoring chapter of the plan also acknowledges data sources and partnerships with user groups as a means to better monitor implementation of the plan.

Revision Topics

Each emphasis area identified in the need for change was considered as a potential revision topic. The need for change considered topics for revision of the forest plan and presented them in four tables. The March 2016 need for change document organized topics into tables. Table A included topics that are required to be addressed in revision by high-level direction. Tables B and C included overarching changes identified through assessments, public comments, tribal consultation, or internal comments. Table D included changes that are made at the discretion of the responsible official. Revision topics help compare and contrast the differences among alternatives.

The need for change process identified topics that direct the need to revise the forest plan. Many of the topics identified in the need for change are addressed in the revision of the forest plan but do not vary by alternative. For example, public involvement comments included in the need for change focused on the desire for the forest plan to be more responsive to changing conditions. A new adaptive management process was included in alternative B (the proposed action), and that is carried throughout all of the action alternatives; therefore, that was not considered to be a significant issue.

Revision Topic 1: Special Designations

The need for change identified several concerns related to special designations. In addition, public comments included many additional designations or changes to existing designations. A need to revise forest plan direction was related to changes in the management of:

- Inclusion of direction for the Old Spanish National Historic Trail,
- Regional and national direction for the Continental Divide National Scenic Trail,
- Inclusion of the Sangre de Cristo National Heritage Area,
- Inclusion of the Rio Grande del Norte National Monument,
- Inclusion of the Cumbres & Toltec National Historic Landmark,
- Evaluation of Mt. Blanca Massif as a significant area,
- Evaluation of the Natural Arch as a significant area, and
- Evaluation of the existing boundary of the John C. Fremont Winter Camp Special Interest Area.

Management of the Sangre de Cristo Natural Heritage Area, Rio Grande del Norte National Monument, and Cumbres & Toltec National Historic Landmark will have little impact to the management of the Rio Grande National Forest. These are all located within the influence zone of the Forest, may bring more visitors to the area over time, and will need to be considered when proposing site-specific management actions. The Cumbres & Toltec National Historic Landmark designation does impact the Forest, but that would be addressed in that individual management area.

Designation of Natural Arch as a special area, and changes to the John C. Fremont Winter Camp Special Interest Area boundary, were both included in alternative B (the proposed action) and do not change across the alternatives. The boundary for the Elephant Rocks Special Interest Area was adjusted to include the Natural Arch/La Ventana geologic feature area and allow for protection and interpretation of this resource. Likewise, the boundary of the John C. Fremont Winter Camp Special Interest Area was reduced in alternative B and remains consistent across the action alternatives. The area was reduced based on study results, and the areas that are no longer designated as special interest areas assumed the neighboring management area designation.

The special interest area for Ripley's milkvetch has been replaced in all action alternatives with plant-specific plan components. The three remaining areas identified as revision topics are addressed differently among the alternatives. The Old Spanish National Historic Trail and the Continental Divide National Scenic Trail are addressed through inclusion of desired conditions, objectives, standards, and guidelines for congressionally designated trails. Additionally, in alternative A both trails are identified as linear features on the *Nationally Designated Trails* map, which is contained on the DVD located at the back of this document. The direction does not include the visual buffers or the plan direction. The trail designations for alternatives B and C are included on the map and identify the visual restraint buffers one-half mile on either side of the trail. Alternative D combines both trails into a new management area specifically for the congressionally designated trails and includes plan direction for the management of the trails.

Mt. Blanca is also addressed differently across the alternatives. The area was brought forward through Tribal consultation as an area of concern for the tribes. This area also was addressed during the public comment process. The no-action alternative identifies this area as Management Area 3.3 – Backcountry. Both alternatives B and D include the area as Management Area 1.1a – Recommended Wilderness, while alternative C included it in the General Forest Management Area. No specific plan direction is included for the area.

Revision Topic 2: Fire Management

Revision of the forest plan to better integrate and clarify direction for the use of prescribed fire and unplanned ignition was identified in the need for change. The fire management zones identified in alternative B are not proposed to change across the other action alternatives; however, this is a significant departure from how fire is managed in alternative A. The need to reduce the risk of a stand-replacing wildfire in beetle-killed forest is at the forefront for both Forest managers and the surrounding communities.

Revision Topic 3: Management Area Complexity

A need to revise and update management area designation and plan direction to minimize complexity and promote ecosystem integrity and connectivity was also identified as a revision topic. The number, size, and configuration of management areas varies across all of the alternatives. Plan direction to address connectivity and key ecosystem characteristics tied to ecosystem integrity are included in all the alternatives.

Revision Topic 4: Recommended Wilderness

Land management planning process requirements contained in Forest Service Manual 1923 and the 2012 Planning Rule state that, "In developing a proposed new plan or proposed plan revision, the responsible official shall: (v) identify and evaluate lands that may be suitable for inclusion in the National Wilderness Preservation System and determine where to recommend any such lands for wilderness designation." While there is little discretion available in conducting the process, the outcomes of the process have provided for a difference among alternatives considered in the analysis. The process includes four steps in determining areas that might be recommended for inclusion in the National Wilderness Preservation System. The Wilderness Inventory Report (USDA Forest Service 2016b) and the Wilderness Evaluation Report (USDA Forest Service 2016c) document the first two steps of the process. The results of the Wilderness Evaluation Report are areas that may be recommended after analyzing the effects. These areas are identified in the analysis as Management Area 1.1a – Recommended Wilderness. Since only Congress can designate wilderness areas, the record of decision will identify which, if any, areas are being recommended to Congress for inclusion in the National Wilderness Preservation System.

Relationship to Other Documents

This document incorporates by reference (40 CFR 1502.21) the management direction and environmental analysis from the following regional programmatic decisions:

- The Southern Rockies Lynx Amendment (2008) and
- Colorado Roadless Rule (2012).

Other Related Efforts – Other Planning Going On

Forest Service planning regulations require the agency to consider other Federal, State, and local government, and Tribal, plans and policies. As part of the outreach effort, a number of discussions with Federal, State, local, and Tribal representatives were initiated, and on-going dialogue continues with respect to incorporating their concerns, where possible. Related planning efforts that were considered include the:

- Colorado Parks and Wildlife State Wildlife Action Plan,
- Carson National Forest Plan Revision,
- Rio Grande County Land Use Plan, and
- Rio Grande del Norte National Monument Plan.

Chapter 2. Alternatives, Including the Proposed Action

Introduction

This chapter describes and compares the alternatives considered for the revision of the forest plan for the Rio Grande National Forest. It includes a description and map of each of the four alternatives considered and presents the alternatives in comparative form, sharply defining the differences between each alternative and providing a clear basis for choice among options by the responsible official. These four maps, along with all of the other maps associated with this draft environmental impact statement, are contained on the DVD that is included at the back of this document.

Forest Plan Components and How They Vary by Alternative

Forest plan direction developed for the action alternatives (B, C, and D) addresses requirements of the 2012 Planning Rule. This direction is not explicitly included in alternative A but is often addressed through other means. Other than lynx direction developed here, forest plan direction is the same across all action alternatives. The different lynx direction is proposed under implementation of alternatives B and D, but not A or C. The direction is incorporated to address the need to retain high-quality understory habitat in beetle-killed forest.

Habitat Connectivity

The 2012 Planning Rule states that forest plans must contain direction to maintain or restore structure, function, composition, and connectivity (36, CFR 219.8). Habitat connectivity was considered in an integrated manner and is maintained through Forestwide and species-specific plan components that focus on maintenance of terrestrial and aquatic ecosystem integrity.

Consultation with staff from other land management agencies and national forests addressed habitat connectivity beyond the Forest boundary. Collaboration addressed connectivity across national forest boundaries as well as boundaries with other land management agencies. Direction included in the Southern Rockies Lynx Amendment considers habitat connectivity within the Forest Service Rocky Mountain Region.

Habitat connectivity can be displayed at a landscape level through existing wilderness acreage, specially designated areas, and Colorado roadless areas, which are incorporated as geographic areas in the action alternatives. Because many of these areas are exempt from large mechanical vegetation treatments, much of the habitat would remain as is.

Alternatives Considered in Detail

Alternatives to the proposed action were developed in response to issues raised during scoping.

Features Common to All Alternatives

All alternatives incorporate higher level direction. This includes other laws, regulation, and policy, as well as programmatic direction such as the Southern Rockies Lynx Amendment and the Colorado Roadless Rule.

No alternatives propose to make any change to existing wilderness acreage in the South San Juan, La Garita, Sangre de Cristo, or Weminuche Wilderness Areas. Likewise, no alternative proposes to make any change to existing Colorado roadless areas.

All applicable amendments to the 1996 forest plan that occurred from 1996 through 2016 are incorporated into all of the alternatives.

All alternatives propose suitability determinations tied to communication sites, renewable energy development, and motorized and mechanized travel in summer and winter. These determinations vary across the alternatives.

The proposed monitoring plan prepared in compliance with the 2012 Planning Rule would not vary across the alternatives.

Acreage of suitable rangeland does not vary by alternative, and gathering of non-timber forest products would occur in all alternatives.

No alternative proposes changes to the developed recreation sites, dispersed recreation areas, trails, or roads.

Alternative A – No Action – Overview

Alternative A is the no-action alternative. This would implement the 1996 forest plan as amended. The 1996 forest plan was prepared and analyzed under the 1982 planning rule. The forest plan has been amended seven times since it was signed in 1996. Anticipated outputs from implementing alternative A for dispersed and developed recreation, locatable and leasable minerals, timber, and grazing are summarized below.

The management emphasis on outdoor recreation features and perpetuates a variety of developed and dispersed recreation opportunities. The qualities and flavor of the Forest are characterized by moderate summer temperatures, abundant snow, clear blue skies, high-elevation country, sparkling cool streams and lakes, and an array of beautiful scenery. The Forest is a welcome respite from crowds and congestion, where visitors can find friendly people, a rich and colorful history, a rich Hispanic culture, and small towns. Demand for dispersed-recreation opportunities has been growing and is expected to continue to do so.

To provide dispersed recreation opportunities and experiences, alternative A would manage a broad spectrum of recreation settings. The mix of recreation settings provides year-round motorized and nonmotorized activities. Balancing the mix of opportunities and resolving use conflicts presents a challenge that requires active management strategies.

Locatable minerals that may be important include gold, silver, and copper. Locatable mineral production is managed according to the General Mining Act of 1872.

The only known leasable minerals are oil and gas. When the 1996 forest plan was signed there were no producing wells on the Forest but there were 23 active leases. All of those leases have since expired. Lease sales proposed in 2008 and 2009 for parcels near South Fork and Del Norte remain deferred as of July 2017.

Lands that *may* be suited for timber production in this alternative are estimated at 499,936 acres. Lands suitable for timber production include those acres where timber production is compatible with the desired conditions and objectives. Alternative A has approximately 320,567 acres of land identified as suitable for timber production.

Alternative A projects about 577,000 acres of land on the Forest as suitable for grazing. A 2002 suitability determination updated that figure to an estimated 581,556 acres, or about 31 percent of the net forest acres. The capacity for livestock grazing was estimated at 143,077 head months in 1996. The current head months actually grazed is approximately 86,649. This figure includes grazing by sheep and cattle.

Alternative A allows the gathering or collection of special forest products such as herbs, mushrooms, rocks, small trees and shrubs, floral products, etc. on a case-by-case basis. The program is administered at the ranger district level.

Generally, if alternative A were selected, updates would be needed to bring it into compliance with the 2012 Planning Rule. Topic areas include sustainable recreation language, timber suitability language, renewable energy direction, and ecosystem services, among others.

Revision Topic #1: Special Designations

No changes would be made to the existing special designations on the Forest. Direction tied to the Continental Divide National Scenic Trail and the Old Spanish National Historic Trail would be included in comprehensive management plans prepared outside of the forest plan. Subsequent analysis could be done to incorporate new areas or change boundaries of existing areas; however, all current boundaries would remain intact under alternative A.

Revision Topic #2: Fire Management

Both prescribed and unplanned fires, both human caused and natural, would continue to be managed as they have been in the past. No new direction is proposed or considered in this alternative.

Revision Topic #3: Management Area Complexity

Alternative A proposes no changes to the existing management areas or inclusions. Areas of the Forest would continue to be managed in compliance with the Colorado Roadless Rule outside of the existing forest plan.

Revision Topic #4: Recommended Wilderness

Alternative A proposes no changes to the existing designated wilderness. No acres of recommended wilderness are included.

Features Common to All Action Alternatives

The three strategic goals presented in Chapter 1 of the forest plan that address water quality and quantity, ecosystem resilience and sustainability, and economics and services provided apply to all action alternatives.

Alternatives B, C, and D all incorporate direction included in the 2012 Colorado Roadless Rule.

The action alternatives propose to incorporate suitable and eligible wild, scenic, or recreational rivers from three separate management areas as they are presented in alternative A (Management Areas 1.5, 3.4, and 4.4) into one management area. Alternatives B and D designate these suitable and eligible segments as Management Area 3.4, while alternative C designates Management Area 4.34. Alternatives B, C, and D all include Deadman Creek as eligible for inclusion to the National Wild and Scenic Rivers System with a wild designation.

An adaptive management process would be incorporated into all proposed action alternatives. This process would require the forest supervisor to meet with interested stakeholders annually to address outputs, monitoring, and proposed changes to forest plan direction. This process is discussed in detail in the Rio Grande National Forest Draft Revised Land Management Plan.

The boundary of the Elephant Rocks Special Interest Area, Management Area 3.1, has been adjusted to include the Natural Arch/La Ventana geologic feature. The John C. Fremont Winter Camp Special Interest Area boundary has been reduced to correspond with recent surveys and analysis that better identifies the camp area. Also, acreage designated as a special interest area for Ripley's milkvetch in the southeast part of the Forest has been removed, and a Forestwide plan component specific to this species was established.

Fire management zones proposed in the action alternatives implement strategic fire management decisions. Areas are pre-assessed for wildland fire (prescribed and wildfire) risks and benefits and are assigned to strategic fire management zones that supports decision-making before wildland fire ignition occurs.

Forest leasable minerals include oil and gas. The Forest is not proposing to amend or expand the direction for leasable minerals in any of the alternatives.

Wildland Fire Management Zone: Resource Restoration (WFMZ-R)

Areas included in this zone present a lower risk to resource values from a wildfire, and conditions allow natural resources to benefit from wildland fire. Managing wildfire to meet resource objectives in this zone is the least constrained.

Ecological restoration would be accomplished by managing wildland fire under a wide range of weather, fuel moistures, and other environmental conditions that allow fire to play its natural role in an ecosystem. The use of prescribed fire to meet specific resource objectives is appropriate in this zone.

All naturally occurring, unplanned wildfires would be managed primarily to restore and maintain the natural role of fire in the ecosystem with a minimal emphasis on suppression. However, if the natural, unplanned wildfire ignites where it poses a threat to communities and other non-natural resource values, suppression action would be taken to mitigate this threat, while allowing the wildfire to play its natural role in the ecosystem.

All wildland fires can be managed for multiple objectives.

All human-caused unplanned wildfires would be managed under a full suppression strategy commensurate with the values at risk.

Wildland Fire Management Zone: Resource Protection and Benefit (WFMZ-PB)

This zone would be applied where current conditions may put some natural resource values at varying degrees of risk for damage from wildfire. This zone also contains areas where conditions place communities and other non-natural resource values at risk of damage from wildfire. Mechanical treatments and prescribed burning may be used to promote ecological restoration before using wildfire under a wider range of weather, fuel moisture, and other environmental conditions. Wildfires that burn in this zone may benefit natural resources under certain conditions.

All natural unplanned wildfires in these areas would be assessed on an individual basis for the most appropriate response based on values at risk and potential benefits to natural resources from a wildfire.

All human caused wildfires would be managed under a full suppression strategy commensurate with the values at risk.

Management Area 5.42 – Special Wildlife Areas – Bighorn Sheep is not included in the action alternatives. Alternatives B and D incorporate the Bighorn Sheep Management Area into Management Area 5.41, which has been retitled Big Game Winter Range (previously Deer and Elk Winter Range). Maps of *Roads within Management Area 5.41 for Alternatives B and D* are contained on the DVD located at the back of this document. Alternative C incorporates the same areas and management direction into the larger designation of Management Area 5 – General Forest and Intermingled Rangelands. This designation provides managers flexibility in applying the management direction where the habitat is actually occurring, based on observed and survey information.

Information from Colorado Parks and Wildlife that includes important areas for winter wildlife survival was included in these determinations. Important areas for bighorn sheep would be mapped and consulted at the project level to mitigate impacts.

Alternative B – Proposed Action – Overview

This alternative is based on a strategic framework that considers direction at two different levels: geographic areas and management areas. The vision is encompassed in three overarching goals that address water quality and quantity, ecosystem resilience and sustainability, and economics and services provided through public land management.

Geographic areas combine areas that have designations resulting from higher level direction, such as wilderness and roadless. In these areas, responsible officials have a more limited decision space. For example, existing wilderness and roadless designations offer the line officer limited levels of discretion in managing these areas. The geographic areas include general forest, primitive wilderness, roadless, and specially designated areas.

Most of the management areas are the same as alternative A, with a few exceptions. These represent the tactical level of management. These areas have smaller scale, integrated desired conditions that are more appropriate for this more discrete land base. Some management areas have direction that is specific to the management of these smaller units. Modifications to existing management areas include a combination of three management areas for wilderness into one; creation of Management Area 1.1a – Recommended Wilderness; creation of management areas based on the 2012 Colorado Roadless Rule; elimination of

3.3 – Backcountry Areas; inclusion of all suitable and eligible wild, scenic, and recreational rivers into one management area; and elimination of the 5.42 – Special Areas – Bighorn Sheep Management Areas.

In response to public input, an adaptive management process is outlined in alternative B and would be addressed in all the action alternatives (B, C, and D). The process proposes that annually, the forest supervisor would provide a public report listing the outputs produced and describing how implementation of the forest plan is progressing. A part of the annual report would address items identified from the plan that needed to be adjusted. Any adjustments to required plan components (desired conditions, suitability determinations, management areas, standards, or guidelines) would require an amendment of the forest plan. Optional plan content (goals or management approaches) may be adjusted using an administrative correction process that includes public involvement.

The monitoring level includes a plan for monitoring implementation of the forest plan based on eight topic areas defined in the 2012 planning rule. The questions would address implementation and effectiveness monitoring that would feed back into necessary amendments or administrative corrections to plan content.

Alternative B continues to provide focus on sustainable outdoor recreation as a primary resource on the Forest. Ongoing management perpetuates undeveloped and diversified dispersed-recreation opportunities at established sites that do not cause unacceptable levels of resource damage. The Forest continues to provide an opportunity for visitors to connect with nature, get away from crowds, and experience the history and views that are provided. As areas of the state become more developed, demand for dispersed-recreation opportunities may increase.

This alternative would provide a broad spectrum of quality dispersed-recreation opportunities and experiences. The mix of recreation settings available provides for summer and winter recreation opportunities while meeting the needs for motorized and nonmotorized recreational use.

Developed recreation includes all recreation activities that take place on a developed recreation site. Managed capacity would be similar to that in alternative A. Demand is expected to remain within the capacity over the 10-year planning period.

Locatable minerals include gold, silver, and copper. These are addressed the same way across all alternatives. All alternatives continue mineral production according to the General Mining Act of 1872.

Lands that *may* be suited for timber production in this alternative are estimated at 499,936 acres. Lands suitable for timber production include those acres where timber production is compatible with the desired conditions and objectives established in the forest plan. Alternative B identifies approximately 468,311 acres of land as suitable for timber production.

While all action alternatives incorporate direction from the Southern Rockies Lynx Amendment, this alternative would implement additional lynx-related direction to address the existing condition in the spruce-fir habitat.

The acres of land suitable for grazing remains the same across all alternatives. About 31 percent of the Forest is identified as suitable for grazing with a capacity of 143,077 head months. This alternative updates the direction brought forward from the previous forest plan to be more accurate with what actually occurs. The Forest is grazed by both sheep and cattle.

This alternative allows for the collection special forest products such as herbs, mushrooms, rocks, small trees and shrubs, floral products, etc. on a case-by-case basis.

Overlapping Management Areas

Overlapping levels of management occur within this alternative. Where the overlap occurs, the most constraining management would be applied. For example where Management Area 1.1 overlaps with other management areas, any management proposed would be done in compliance with wilderness direction. Overlapping management areas are described below.

Approximately 12,431 acres of Management Area 2.2 – Research Natural Areas occur inside of wilderness area boundaries. Research natural areas are designated by the regional forester with concurrence of the research station director. These areas are designated to preserve representative areas that typify important forest, shrubland, grassland, alpine, aquatic, geologic, or other natural environments, or areas that have special or unique characteristics of scientific importance. These areas are used as a baseline for measuring ecological changes and as control areas for evaluation and monitoring. The estimated 12,431 acres of research natural areas that overlap with wilderness include three areas in the Sangre de Cristo range: namely the Mill Creek, Deadman Creek, and North Zapata Research Natural Areas. A portion of the Mill Creek Research Natural Area overlaps with recommended wilderness as well.

An estimated 15,575 acres of wilderness is also managed as Management Area 3.4 – Suitable and Eligible Wild, Scenic, or Recreational Rivers. These areas would be managed to enhance or maintain the outstandingly remarkable features responsible for designation of the rivers while complying with wilderness practices and restrictions. Approximately 2,393 acres of Management Area 3.4 overlaps with Management Area 1.1a – Recommended Wilderness.

Additionally, an estimated 554 acres of overlapping management occurs with research natural areas and eligible and suitable wild, scenic, and recreational rivers. Any management that might occur in these areas would have to be in compliance with all management areas.

Approximately 856 acres of recommended wilderness (Management Area 1.1a) overlap with Management Area 3.4 – Suitable and Eligible Wild, Scenic, and Recreational River and Special Interest Area. Management proposed on these acres would have to be in compliance with wilderness if that area is carried forward in the analysis, with wild, scenic, and recreational river direction, and with any direction for that specific special interest area.

Lastly, approximately 2,948 acres of recommended wilderness (Management Area 1.1a) overlap with existing special interest areas (Management Area 3.1). Any activities or management proposed in this area would have to be done in compliance with wilderness practices and meet direction for that specific special interest area.

Research natural areas also overlap with the acres designated as Colorado roadless areas. The 4,825 acres overlap with roadless areas in the Finger Mesa Research Natural Area on the Divide Ranger District. If management were to occur on these acres it would have to be compliant with both the direction for the research natural area and the roadless designation.

Special interest areas (Management Area 3.1) also occur in designated research natural areas. Any management proposed on the 8,510 acres where overlaps occur would have to meet both direction for the research natural area as well as the intent of the special interest area.

Revision Topic #1: Special Designations

Alternative B proposes to remove the special interest area for Ripley's milkvetch. A 1999 forest plan amendment adjusted the original boundary of the special interest area to more accurately reflect the actual location of the plant. Since 1999, staff have found the plant to be more widespread, and the special area was replaced with Forestwide direction to protect the species, which is proposed as a species of conservation concern. The acres previously in the special interest area are now included as big game winter range.

Alternative B also proposes to reduce the acreage of the John C. Fremont Winter Camp Special Interest Area from 10,830 acres to 8,422 acres due to archaeological survey work recently completed that confirms the location of the heritage resources that need to be protected. Most of the acres were transferred to Management Area 5.13 – Forest Products. Alternative B also proposed to adjust the boundary of the Elephant Rocks Special Interest Area to include the Natural Arch/La Ventana geologic feature as an area of tribal importance.

No additional acres are proposed for inclusion as research natural area.

The Colorado Roadless Rule has been included as Roadless Management Area 3.5 and Upper Tier, Management Area 3.6. Direction included in the 2012 Colorado Roadless Rule have been incorporated as management area direction.

Revision Topic #2: Fire Management

Fire management zones would be incorporated in this alternative. Refer to *Features Common to All Action Alternatives,* above, for a description of these zones.

Revision Topic #3: Management Area Complexity

This alternative incorporates geographic areas that better describe the designated land status and available discretion to responsible officials. This alternative proposes to incorporate the Colorado Roadless Rule into forest plan direction by creating two new management areas, Management Area 3.5 Roadless, and Management Area 3.6 Upper Tier Roadless.

Two management areas are not used in this alternative. Management Area 3.3 – Backcountry is mostly assumed by the roadless designations. What was not designated as roadless has been incorporated into the next closest area.

Revision Topic #4: Recommended Wilderness

This alternative includes an estimated 59,000 acres of recommended wilderness. This is the result of a process that included inventory of areas that met defined criteria as having potential for wilderness. The inventory and evaluation of the inventoried areas for wilderness characteristics is thoroughly described in the wilderness inventory and evaluation reports posted to the forest website. These areas are shown in reports and on maps as Management Area 1.1a.

Alternative C – Overview

This alternative proposes to increase the acreage available for multiple uses on the Forest. No recommended wilderness acres would be included in this alternative. This alternative addresses concerns about complexity by reducing the number of management areas and making those boundaries similar to the geographic area boundaries in alternative B. These larger units of land provide more flexibility in implementation of the forest plan by allowing habitat and areas to be mapped dependent on actual presence versus providing a static management area boundary.

Management area designation numbers were adjusted to maintain consistency with the reasons the areas were originally designated (Table 1). Management area direction remains the same and would not change across alternatives.

Table 1. Management area designations by alternative

Management Area Title	Management Area Number			
	Alternative A	Alternative B	Alternative C	Alternative D
Wilderness	1.11, 1.12, 1.13	1.1	1	1.1
Roadless	None	3.5, 3.6	3	3.5, 3.6
Special Interest Areas	3.1	3.1	4.1	3.1
Research Natural Areas	2.2	2.2	4.2	2.2
Scenic Byway and Railroad	4.21	4.21	4.21	4.21
Suitable and Eligible Wild, Scenic and Recreational Rivers	1.5 (Wild) 3.4 (Scenic) 4.4 (Recreational)	3.4	4.34	3.4
Ski-based Resorts	8.22	8.22	4.8	8.22
General Forest and Rangeland	5.11, 5.13, 6.6	5.11, 5.13, 6.6	5	5.11, 5.13, 6.6

This alternative would synchronize the off-road game retrieval polices with the Forest's motor vehicle use map and would shift time frames for retrieval.

Recreation opportunities would continue at the same levels as described in alternatives A and B.

Alternative C proposes no change from alternatives A and B in the locatable and leasable minerals direction for the Forest.

Lands that *may* be suited for timber production in this alternative are estimated at 499,936 acres. This alternative includes more acres in the suitable timber bases, with approximately 480,683 acres of land as suitable for timber production.

Grazing direction and levels would be the same as for the previous alternatives.

Revision Topic #1: Special Designations

Same as for alternative B.

Revision Topic #2: Fire Management

Fire management zones are the same as for alternative B.

Revision Topic #3: Management Area Complexity

This alternative proposes eight management areas. Refer to the above *Alternative C – Overview* section and Table 3 in the *Comparison Tables for Alternatives* section.

Revision Topic #4: Recommended Wilderness

This alternative does not include any acres of recommended wilderness.

Alternative D – Overview

This alternative presents the same management framework as alternative B with management areas nested under broader geographic areas. Some geographic areas are based on designations that establish line officer discretion at a strategic level. For example, existing wilderness and roadless areas offer the line officer limited levels of discretion in managing these areas. The remaining areas are Forest-level and higher specially designated areas, and the remaining general forest management area. The geographic areas include general forest, primitive wilderness, roadless, and specially designated areas.

This alternative emphasizes less active management of resources while increasing the amount of area available for recreation opportunities that provide for a more solitary experience. This alternative incorporates elements of proposals submitted by the public and increases opportunities for semiprimitive, nonmotorized recreation.

This alternative would increase the number of acres proposed for wilderness to expand opportunities for wilderness experience. Many areas determined to have moderate to high or high characteristics in the wilderness evaluation process are included, as well as additional areas.

This alternative proposes additional special interest areas and areas that emphasize management of native fish, as well as areas based on cultural and botanical resources and tribal uses. This alternative proposes the addition of Management Area 4.23 for congressionally designated trails, including both the Continental Divide National Scenic Trail and the Old Spanish National Historic Trail.

Alternative D proposes additional designated areas that would maximize connectivity of wildlife habitat and increase opportunities for primitive and semiprimitive visitor experiences. This alternative proposes one new research natural area on Sheep Mountain and seven additional special interest areas to enhance wildlife connectivity, native fish habitat, and watershed protection, as well as protect unique geologic features and one area of tribal importance. These areas are in addition to those proposed in alternatives B and C.

- Cumbres & Toltec National Historic Landmark Special Interest Area
- Spruce Hole/Osier/Toltec Special Interest Area
- Chama Basin Special Interest Area
- Summer Coon/La Ventana Special Interest Area
- Carnero Creek Special Interest Area

- Jim Creek Special Interest Area
- Deep Creek Special Interest Area

Additionally, off-road game retrieval would no longer be allowed on the Forest.

This alternative would limit future development by proposing more areas of recommended wilderness and special interest areas. Creating areas of focus on native fish habitat would add opportunities to leverage existing partnerships to increase and enhance habitat available.

Developed recreation opportunities would remain the same as for alternatives A, B, and C. Additional wilderness recommendations in this alternative would result in a reduction of motorized opportunities Forestwide. Over time, existing transportation systems and motorized trails would be reduced to protect wilderness character. Opportunities for primitive recreation experiences would increase under this alternative.

There would be no change from alternative A and B in locatable and leasable mineral direction and availability.

The volume of forest products harvested would be reduced under alternative D. There would be less opportunity to recover value from many acres of the beetle-killed forest because areas of recommended wilderness would be managed to protect wilderness characteristics. Lands that *may* be suited for timber production in this alternative are estimated at 499,936 acres. Alternative D identified approximately 401,414 acres of land as suitable for timber production.

While all action alternatives incorporate direction from the Southern Rockies Lynx Amendment, this alternative would implement additional lynx-related direction to address the existing condition in the spruce-fir habitat.

The suitable acres and amount of grazing could be reduced in some areas if it is determined that livestock grazing is not a compatible use in areas being designated for special interests. That is not able to be determined at this time. This alternative is anticipated to result in an increased cost to grazing. Having more acres in a protected status, such as recommended wilderness, would limit the ability to use motorized and mechanized travel in managing allotments and livestock. Materials would have to be brought in on foot or horseback for longer distances.

Gathering of non-timber forest products would continue; however, access to areas in recommended wilderness and special interest areas may be reduced.

Overlapping Management Areas

Overlapping levels of management occur in this alternative. Where the overlap occurs, the most constraining management would be applied. For example, where Management Area 1.1 overlaps with other management areas, any management proposed would be done in compliance with wilderness direction. Overlapping management areas are described below.

About 1,200 additional acres are proposed in Management Area 2.2 – Research Natural Area, increasing the total acres to an estimated 25,154. Of the total, approximately 12,431 acres of research natural areas occur within wilderness area boundaries, similar to alternative B. The additional 1,200 acres is in the Sheep Mountain area, described later in this document.

Similar to alternative B, an estimated 15,575 acres of wilderness is also managed as Management Area 3.4 – Suitable and Eligible Wild, Scenic, or Recreational River. These areas are managed to enhance or maintain the outstandingly remarkable features responsible for the river designation while complying with wilderness practices and restrictions. Approximately 2,393 acres of Management Area 3.4 overlap with Management Area 1.1a – Recommended Wilderness.

Additionally, an estimated 554 acres of overlapping management occurs with research natural areas and eligible and suitable wild, scenic, and recreational rivers. Any management that might occur in these areas would comply with direction from all applicable management areas.

Approximately 856 acres of recommended wilderness (Management Area 1.1a) overlap with Management Area 3.4 – Suitable and Eligible Wild, Scenic, and Recreational Rivers and Special Interest Areas. Management proposed on these acres would have to be in compliance with wilderness management direction if that area is carried forward in the analysis, with wild, scenic, and recreational river direction, and with any direction for that specific special interest area.

Lastly, approximately 2,948 acres of recommended wilderness (Management Area 1.1a) overlap with existing special interest areas (Management Area 3.1). Any activities or management proposed in this area would have to be done in compliance with wilderness practices and meet direction for that specific special interest area.

Research natural areas also overlap with the acres designated as Colorado roadless areas. The 4,825 acres overlap with roadless areas in the Finger Mesa Research Natural Area on the Divide Ranger District. If management were to occur on these acres it would have to be compliant with both the direction for the research natural area and the roadless designation.

Special interest areas (Management Area 3.1) also occur in designated research natural areas. Any management proposed on the 8,510 acres where overlap occurs would have to meet direction for both the research natural area as well as the intent of the special interest area.

Additional overlaps in this alternative include Management Area 4.23. This management area is approximately 83,997 acres of congressionally designated trails that would overlap primarily with wilderness and Colorado roadless designation. As previously stated, the most limiting management area designation would take precedence in management.

Revision Topic #1: Special Designations

The Continental Divide National Scenic Trail and the Old Spanish National Historic Trail are proposed to be included in Management Area 4.23 – Congressionally Designated Trails. This management area includes the total visual corridor as defined in trail management guidance. Making a management area for the trails provides consistent management direction across the Forest. In alternatives A, B, and C the trails pass through multiple management areas, leaving the direction open to potential differences in interpretation.

Additional acres of specially designated areas overall are proposed in alternative D. This includes changes in boundaries of existing special areas such as Elephant Rocks, proposed new research natural areas, new special interest areas at Spruce Hole, Osier, and Toltec, and special areas created for focus management, including the native fish habitat areas at Carnero and Jim Creek.

In total, this alternative proposes an estimated 316,000 acres of specially designated areas.

Revision Topic #2: Fire Management

Fire management zones are included.

Revision Topic #3: Management Area Complexity

This alternative is similar to alternative B, with one addition. Almost 16,000 acres of Management Area 3.3 – Backcountry is included in this alternative.

Revision Topic #4: Recommended Wilderness

This alternative proposes approximately 285,000 acres of recommended wilderness. Many of these areas are currently managed to protect roadless and backcountry values. Management changes would be slight but would result in a reduction in over-snow, mechanical, and motorized use across the Forest.

Alternatives Considered but Eliminated from Detailed Study

Federal agencies are required by the National Environmental Policy Act 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 in response to the proposed action provided suggestions for alternatives, a number of which were considered. The rationale for eliminating potential alternatives, or components of an alternative, from detailed consideration is summarized below.

The Forest received one complete suggested alternative. The alternative was reviewed in detail. Some suggestions were carried forward into the four alternatives presented here. Other suggestions were not included and the reasons are discussed below.

The alternative submitted included recommendations for research natural areas. One of these, Sheep Mountain, was carried forward in alternative D. Other recommendations were brought forward as a potential special interest area. Research natural areas are established by the regional forester with concurrence of the station director. The recommendation is made by the local forest supervisor as a result of analyses conducted for forest planning or outside the planning process. Areas can also be established by the regional research natural area committee established by the regional forester and station director. The additional research natural areas included in the analysis came from public involvement and were not suggested by the forest supervisor. No research natural area committee is currently assembled.

Sage-grouse protection areas were proposed. The Forest does not have an appreciable amount of habitat for the Gunnison sage-grouse. Management direction for sage-grouse is included in all action alternatives, and recommended wilderness acres included in alternatives B and D would provide additional species protection.

It was recommended that the Wolf Creek linkage area be made a special interest area. Because linkage areas and associated direction are adequately identified in the Southern Rockies Lynx Amendment, no additional plan direction is included.

Plan components associated with focal wetland complexes were presented in the alternative. The intent of the direction is a prime consideration of the 2012 Planning Rule. Analysis for aquatic ecosystem integrity and associated direction is intended to reduce impacts to aquatic ecosystems. Existing handbook direction and additional wetland-specific direction meets this purpose.

Suggestions included elimination of grazing in existing and proposed research natural areas. In general, grazing is not authorized in research natural areas on the Forest, with one exception. The Hot Creek Research Natural Area is part of the Hot Creek Allotment, which is grazed under a valid permit; however, this area is generally not grazed because it is inaccessible. The current permittees have agreed to continue to not graze the area within the research natural area.

The alternative suggested that protected areas, big game winter range, calving and fawning grounds, bighorn sheep areas, wetlands, riparian areas, campgrounds, and other areas be determined as unsuitable for renewable energy development. Suitability for renewable energy is included in the forest plan. Associated direction that would be implemented at the project level to reduce, mitigate, or eliminate impacts to sensitive habitats if they occur in areas determined to be suitable is also included.

Comparison Tables for Alternatives

The following tables summarize the effects of implementing each alternative by geographic area, management area, recommended wilderness, and fire management zone. Table 2 and Table 3 focus on differences in acreage related to a management focus or land allocation. Table 4 lists the effects of each alternative on furthering the proposed Forestwide goals, and Table 5 lists the effects of each alternative on addressing the revision topics discussed earlier in this chapter.

Summary Comparison of Geographic Areas, Recommended Wilderness, and Fire Management Zones by Alternative

Alternative A does not use geographic areas and in alternative C, geographic areas become management areas (Table 2). In alternatives B, C, and D, Lower Deadman Creek is eligible for scenic designation.

Table 2. Geographic areas by alternative

	Alternative A	Alternative B	Alternative C	Alternative D
Geographic Areas	No	Yes	No	Yes
Primitive Wilderness (acres)		416,909		614,155
Roadless (acres)		472,388		214,231
Specially Designated Areas (acres)		114,416		316,085
General Forest (acres)		833,549		692,794
Recommended Wilderness (acres)	0	58,669	0	284,853
Number of Management Areas	17	14	8	16
Total Eligible Wild, Scenic, and Recreational Rivers (acres)	30,194	35,872	35,872	35,872
Resource Restoration Wildland Fire Management Zone (acres)	0	889,297	889,297	828,386
Resource Protection and Benefit Wildland Fire Management Zone (acres)	0	947,965	947,965	1,008,879

Table 3. Management areas by alternative

[Reported in acres. Overlapping management areas can make it appear that additional areas are considered. However, the most limiting management area direction takes precedence over any other management. For example, a special interest area that occurs in wilderness may have proposed management; however, any management would have to comply with wilderness management direction.]

Management Areas	Alternative A	Alternative B	Alternative C[1]	Alternative D
General Forest Geographic Area				
Management Area 4.3 – Dispersed and Developed Recreation	92,947	101,218		73,053
Management Area 5 – General Forest/Rangelands			861,029	
Management Area 5.11 – General Forest and Intermingled Rangelands	183,676	155,330		134,937
Management Area 5.13 – Forest Products	265,016	248,689		204,735
Management Area 5.41 – Deer and Elk (Big Game) Winter Range	192,922	269,383		235,942
Management Area 5.42 – Special Wildlife Areas – Bighorn Sheep	77,645			
Management Area 6.6 – Grassland Resource Production	74,356	58,849		27,117
Primitive Wilderness Geographic Area				
Management Area 1 – Wilderness			392,139	
Management Area 1.1 – Wilderness		392,139		392,139
Analyzed Wilderness 1.1a – Recommended Wilderness		58,669		284,853
Management Area 1.11 – Wilderness-Pristine	136,544			
Management Area 1.12 – Wilderness-Primitive	171,335			
Management Area 1.13 – Wilderness Semiprimitive	84,210			
Management Area 1.5 – Eligible Wild Rivers	9,252	Combined into Management Area 3.4		
Roadless Geographic Area				
Management Area 3 – Roadless			498,240	
Management Area 3.5 – Roadless	0	155,744		90,198
Management Area 3.6 – Upper Tier Roadless	0	329,977		124,033
Specially Designated Geographic Area				
Management Area 2.2 – Research Natural Area	23,868	23,868		25,154[2]
Management Area 3.1 – Special Interest Area	34,666	26,966		148,920
Management Area 3.3 – Backcountry	464,282			16,927

Management Areas	Alternative A	Alternative B	Alternative C[1]	Alternative D
Management Area 3.4 – Eligible and Suitable Wild, Scenic, and Recreational Rivers[3]	10,133	35,872		35,872
Management Area 4.1 – Special Designation: Special Interest Area			26,096	
Management Area 4.2 – Special Designation: Research Natural Area			23,798	
Management Area 4.21 – Scenic Byway and Railroad	27,487	27,487	27,487	27,487
Management Area 4.23 – Special Designation: Congressionally Designated Trail				83,997
Management Area 4.34 – Eligible and Suitable Wild, Scenic, and Recreational Rivers[4]			35,872	
Management Area 4.4 – Eligible and Suitable Recreational Rivers	10,809			
Management Area 4.8 – Special Designation: Ski-based Resorts			1,632	
Management Area 8.22 – Ski Based Resorts	1,632	1,632		446

[1] Alternative C presents many of the same management areas as alternatives A, B, and D, with different designations. Management Area 4.1 is special interest areas, Management Area 3.1 in the other alternatives. Management Area 4.2 is the research natural area, which is Management Area 2.2 in other alternatives. Management Area 4.34 is the wild, scenic, and recreational rivers, Management Area 3.4 in alternatives B and D. Management Area 4.8 is the Ski-based Resort Management Area, which is 8.22 in other alternatives. Management areas in alternative C were renamed to maintain consistency with the numbering scheme.

[2] Includes acres for Sheep Mountain potential research natural areas.

[3] Action alternatives combine wild, scenic, and recreational rivers into one management area.

[4] Rivers and river segments suitable and eligible for wild, scenic, and recreational rivers varies across alternatives. Alternative A, no action, includes the rivers in three separate management areas (1.5, 3.4, and 4.4). Alternative B combines the three rivers into one management area. Alternatives C and D propose to move the three river areas into Management Area 4.34. All specially designated areas proposed in alternative C begin with 4.

Table 4. Comparison of Forestwide goals and objectives by alternative

<table>
<tr><th>Alternative</th><th>Goal 1: Protect and restore watershed health, water resources, aquatic ecosystems, and the systems that rely on them</th><th>Goal 2: Maintain and restore sustainable, resilient terrestrial ecosystems</th><th>Goal 3: Actively contribute to social and economic sustainability in the broader landscape and connect citizens to the land</th></tr>
<tr><td>A</td><td colspan="3">The three goals were established to address revision of the 1996 forest plan, which is represented by alternative A. Although alternative A was not specifically developed to protect watersheds, restore resilient ecosystems, and contribute to social and economic sustainability, these goals would be achieved at some level if implementation of the 1996 forest plan continued.</td></tr>
<tr><td>B</td><td colspan="3">Alternative B was developed to meet the goals prescribed. The flexibility proposed in this alternative, as well as the other action alternatives, would allow forest management to be more responsive if emphasis on a particular goal needed to be adjusted.</td></tr>
<tr><td>C</td><td colspan="3">Alternative C would meet all three goals, with an emphasis on using the tools available under Goal 3 to help meet Goals 1 and 2. Goal 3 better meets the contributions to economic sustainability while emphasizing extraction of forest products during the planning period.</td></tr>
<tr><td>D</td><td colspan="3">While all three goals would be met, alternative D emphasizes natural processes and protection to meet goals 1 and 2. This alternative would have a more recreational and nonmotorized emphasis in connecting citizens to the land in Goal 3 while still meeting Goals 1 and 2.</td></tr>
</table>

Table 5. Comparison of revision topic by alternative

[MA, Management Area]

Alternative	Topic 1: Special Designations	Topic 2: Fire Management	Topic 3: Management Area Complexity	Topic 4: Recommended Wilderness
A	No new acres. Existing: 34,666 acres MA 3.1 23,868 acres MA 2.2	Management Area direction on fire suppression	Seventeen management areas with some inclusions of overlapping management direction	0 acres
B	Adjusted boundary for John C. Fremont and Elephant Rock Special Areas, 26,966 acres of MA 3.1 23,868 acres of MA 2.2	Two fire management zones proposed. WFMZ-R acres 889,297 WFMZ-PB acres 947,965	Four geographic areas with 14 management areas, some with overlapping management direction	58,669 acres
C	Existing: 26,096 acres of MA 4.1 23,798 acres of MA 4.2	Two fire management zones proposed. WFMZ-R acres 889,297 WFMZ-PB acres 947,965	Eight management areas with some overlapping management direction – creates new management area numbers	0 acres
D	148,920 acres of MA 3.1 25,154 acres of MA 2.2	Two fire management zones proposed. WFMZ- R acres 828,386 WFMZ-PB acres 1,008,879	Four geographic areas with 16 management areas, some with overlapping management direction	284,853 acres

Comparison of Suitable Activities by Alternative

Suitable activities across the alternatives are presented in Table 6, Table 7, Table 8, and Table 9. As identified in the *Purpose and Need for Action* section, the Forest intends to make suitability determinations regarding where and when particular activities may occur. These activities include renewable energy development, winter and summer motorized and mechanized travel, and communication sites, among others.

Table 6. Suitable activities for each management area, alternative A

Activity	Management Area																
	1.11	**1.12**	**1.13**	**1.5**	**2.2**	**3.1**	**3.3**	**3.4**	**4.21**	**4.3**	**4.4**	**5.11**	**5.13**	**5.41**	**5.42**	**6.6**	**8.22**
Hiking trail construction		x	x			x	x	x	x	x	x	x	x	x	x	x	
Bicycle trail construction						x	x		x	x	x	x	x	x	x	x	
Horseback riding trail construction		x	x			x	x		x	x	x	x	x			x	
Livestock grazing	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
Commercial timber harvest												x	x				
Prescribed fire	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Motorized travel					x	x		x	x	x	x	x	x	x		x	
Mechanized travel					x	x	x	x	x	x	x	x	x	x	x	x	
Off road travel for dispersed recreation/firewood gathering										x		x	x	x			
Salvage/sanitation harvest									x	x		x	x	x	x	x	
Silvicultural treatments not for timber production						x				x		x	x	x			
Oil and gas leasing					x	x	x	x	x	x	x	x	x	x	x	x	x
Off-road game retrieval										x	x	x	x	x	x	x	x
Renewable energy development									x	x	x	x	x	x	x	x	
Communication sites									x	x	x	x	x	x	x	x	x
Over-snow motorized travel						x	x	x	x	x		x	x	x	x	x	

In alternative A, grazing is suitable in only one research natural area, specifically Hot Creek Research Natural Area. Motorized and mechanized travel is suitable only on designated routes.

Communication sites and renewable energy development are also subject to project-specific environmental review. Over-snow motorized travel is suitable in only three special interest areas—specifically the Bachelor Loop, Elephant Rocks, and Wagon Wheel Gap Experimental Station—and may be subject to timing restrictions to protect deer and elk winter range.

Table 7. Suitable activities for each management area, alternative B

Activity	Management Area													
	1.1	1.1a	2.2	3.1	3.4	3.5	3.6	4.21	4.3	5.11	5.13	5.41	6.6	8.22
Hiking trail construction				x	x	x	x	x	x	x	x	x	x	
Bicycle trail construction				x		x	x	x	x	x	x	x	x	
Horseback riding trail construction				x		x	x	x	x	x	x		x	
Livestock grazing	x		x	x	x	x	x	x	x	x	x	x	x	
Commercial timber harvest										x	x			
Prescribed fire	x		x	x	x	x	x	x	x	x	x	x	x	x
Motorized travel			x	x	x			x	x	x	x	x	x	
Mechanized travel			x	x	x	x	x	x	x	x	x	x	x	
Off road travel for dispersed recreation/firewood gathering									x	x	x	x		
Salvage/sanitation harvest								x	x	x	x	x	x	
Silvicultural treatments not for timber production				x					x	x	x	x		
Oil and gas leasing			x	x	x	x	x	x	x	x	x	x	x	
Off-road game retrieval									x	x	x	x	x	x
Renewable energy development								x	x	x	x	x	x	
Communication sites								x	x	x	x	x	x	x
Over-snow motorized travel				x	x	x	x	x	x	x	x	x	x	

In alternative B, grazing is still suitable in only one research natural area, specifically Hot Creek Research Natural Area. Motorized and mechanized travel is suitable only on designated routes.

Communication sites and renewable energy development are also subject to project-specific environmental review. Over-snow motorized travel is suitable in only three special interest areas—specifically the Bachelor Loop, Elephant Rocks, and Wagon Wheel Gap Experimental Station—and may be subject to timing restrictions to protect deer and elk winter range.

Table 8. Suitable activities for each management area, alternative C

Activity	Management Area							
	1	3	4.1	4.2	4.21	4.34	4.8	5
Hiking trail construction		x			x	x		x
Bicycle trail construction		x			x	x		x
Horseback riding trail construction		x			x	x		x
Livestock grazing	x	x		x	x	x		x
Commercial timber harvest								x
Prescribed fire	x	x		x	x	x	x	x
Motorized travel				x	x	x		x
Mechanized travel		x		x	x	x		x
Off road travel for dispersed recreation/firewood gathering						x		x
Salvage/sanitation harvest					x	x		x
Silvicultural treatments not for timber production						x		x
Oil and gas leasing		x	x	x	x	x	x	x
Off-road game retrieval					x	x		x
Renewable energy development					x	x		x
Communications sites					x	x	x	x
Over-snow motorized travel		x	x		x	x		x

In alternative C, grazing is suitable in only one research natural area, specifically Hot Creek Research Natural Area. Motorized and mechanized travel is suitable only on designated routes.

Communication sites and renewable energy development are also subject to project-specific environmental review. Over-snow motorized travel is suitable in only three special interest areas—specifically the Bachelor Loop, Elephant Rocks, and Wagon Wheel Gap Experimental Station—and may be subject to timing restrictions to protect deer and elk winter range.

Table 9. Suitable activities for each management area, alternative D

Activity	Management Area															
	1.1	1.1a	2.2	3.1	3.3	3.4	3.5	3.6	4.21	4.23	4.3	5.11	5.13	5.41	6.6	8.22
Hiking trail construction				x	x		x	x	x	x	x	x	x	x	x	
Bicycle trail construction				x	x		x	x	x		x	x	x	x	x	?
Horseback riding trail construction				x	x		x	x	x	x	x	x	x		x	
Livestock grazing	x		x	x	x	x	x	x	x	x	x	x	x	x	x	
Commercial timber harvest												x	x			
Prescribed fire	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x
Motorized travel			x	x	x	x			x		x	x	x	x	x	
Mechanized travel			x	x	x	x	x	x	x		x	x	x	x	x	
Off road travel for dispersed recreation/firewood gathering											x	x	x	x		
Salvage/sanitation harvest									x		x	x	x	x	x	
Silvicultural treatments not for timber production				x	x						x	x	x	x		
Oil and gas leasing			x	x	x	x	x	x	x	x	x	x	x	x	x	x
Off-road game retrieval																
Renewable energy development									x	x	x	x	x	x	x	
Communications sites									x	x	x	x	x	x	x	x
Over-snow motorized travel				x	x	x	x	x	x	x	x	x	x	x		

In alternative D, where management areas overlap, the most restrictive management applies. Alternative D also includes a new management area specific to congressionally designated trails, listed below under 4.3.

In alternative D, grazing is still suitable in only one research natural area, specifically Hot Creek Research Natural Area. Motorized and mechanized travel is suitable only on designated routes.

Communication sites and renewable energy development are also subject to project-specific environmental review. Over-snow motorized travel is suitable in only three special interest areas—specifically the Bachelor Loop, Elephant Rocks, and Wagon Wheel Gap Experimental Station—and may be subject to timing restrictions to protect deer and elk winter range. Off-road game retrieval is prohibited in all management areas.

Comparison of Alternatives by Program

Fuels Management

Alternatives B, C, and D propose incorporation of wildfire management zones. Acreage in each zone is listed by alternative in Table 10. Wildfire management zones are not included in alternative A.

Table 10. Distribution of wildfire management zones, by alternative

	Alternative A	Alternative B	Alternative C	Alternative D
WFMZ-R: Resource Restoration Wildland Fire Management Zone (acres)	0	889,297	889,297	828,386
WFMZ-PB: Resource Protection and Benefit Wildland Fire Management Zone (acres)	0	947,965	947,965	1,008,879

Long-Term Sustained Yield for Timber Harvest

About 27 percent of the 1.8 million acres of Forest lands are identified as may be suitable for timber production (see the *Timber Suitability – May Be Suitable for Timber Production* map, which is contained on the DVD located in the back of this document). Even though lands may be suitable for timber production, they may not be feasible for timber production. Feasibility for timber production is determined at the project level. Based on the may be suitable acreage, the estimated sustained yield limit is 7,374,937 cubic feet per year or 73,749 CCF per year.

Based on the long-term sustained yield limit, first decade estimates for a planned timber sale program for all alternatives are shown in Table 11. The second decade estimates are listed by alternative in Table 12. Estimates of projected timber sale quantity listed in the table do not include salvage harvest.

Table 11. First decade estimates of planned timber sale program (annual average volume output) for all alternatives

	Alternatives A and B (CCF)	Alternative C[1] (CCF)		Alternative D (CCF)
		Year 1 through 6	Year 7 through 10	
Projected Timber Sale Quantity	700	0	15,000	500
Other Estimated Wood Products (Fuelwood)	7,200	7,200	7,200	7,200
Projected Wood Sale Quantity[2]	7,900	7,200	22,200	7,700
Estimated Salvage Volume	32,100	62,800	0	17,300
Total Volume including Salvage[3]	40,000	70,000	22,200	25,000

[1] Alternative C proposes an increased harvest rate from year 1 through 6 of the first decade followed by a slower rate at the end of the first decade.

[2] Projected wood sale quantity is the projected timber sale quantity added to the other estimated wood products (fuelwood).

[3] Under all alternatives, volume may not be evenly distributed over the time period but may be higher during the initial years of the time period and lower during the later years of the time period.

Table 12. Second decade estimates of planned timber sale program (annual average volume output) for all alternatives

	Alternatives A and B (CCF)	Alternative C (CCF)	Alternative D (CCF)
Projected Timber Sale Quantity	8,400	15,000	4,000
Other Estimated Wood Products (Fuelwood)	7,200	7,200	7,200
Projected Wood Sale Quantity[1]	15,600	22,200	11,200
Estimated Salvage Volume	0	0	0
Total Volume including Salvage	15,600	22,200	11,200

[1] Projected wood sale quantity is the projected timber sale quantity added to the other estimated wood products (fuelwood).

Timber Harvest Constraints and Timber Suitability Required by the National Forest Management Act

Suitable timber acreage for each alternative is listed in Table 13.

Table 13. Timber suitability by alternative

	Alternative A (acres)	Alternative B (acres)	Alternative C (acres)	Alternative D (acres)
Estimated Forest Total	1,837,000	1,837,000	1,837,000	1,837,000
Lands not suited for timber production due to legal or technical reasons	1,337,064	1,337,064	1,337,064	1,337,064
Lands that may be suited for timber production	499,936	499,936	499,936	499,936
Total lands suitable for timber production (timber production is compatible with the desired conditions and objectives established by the plan)	320,567	468,311	480,683	401,414
Total lands not suited for timber production	1,516,433	1,368,689	1,356,317	1,435,586

Livestock Grazing

The number of acres capable for grazing for each management area is listed by alternative in Table 14.

Table 14. Capable acres for cattle and sheep grazing, by management area

[Reported in acres. Management areas not included in all alternatives shown in parentheses.]

Management Area	Alternative A		Alternative B		Alternative C		Alternative D	
	Cattle	Sheep	Cattle	Sheep	Cattle	Sheep	Cattle	Sheep
1.0 – Wilderness (C)					61,511	9,490		
1.1– Wilderness (B and D)			64,926	11,144			64,926	11,144
1.11- Wilderness Pristine	16,084	4,741						
1.12-Wilderness – Primitive	41,930	5,525						
1.13- Wilderness – Semiprimitive	6,831	862						
1.5-Designated and Eligible Wild River (A)	1,071	128						
1.1a-Recommended Wilderness	0	0	6,500	1,312			60,179	9,145
2.2-Research Natural Area[1]	2	0	2	0			346	28
3.0-Roadless (C)					114,069	21,001		
3.1-Special Interest	13,800	560	5,759	103	0	332	58,230	1,644
3.3-Backcountry	109,636	18,017					6,511	677
3.4-Designated and eligible (A) Scenic River; (B and C) WSR	2,552	265	7,084	1,170			7,514	2,246
3.5-Roadless	0	0	37,507	7,677			21,090	5,341
3.6-Upper Tier Roadless	0	0	75,834	12,624			23,630	5,909
4.1-Special Interest Areas (C)					9,369			
4.2-Research Natural Areas (C)					65			
4.21-Scenic Byway and Railroad	12,981	865	12,909	850	12,922	850	11,884	825
4.23-Congressionally Designated Trail (D)							17,332	776
4.3-Dispersed and Developed Recreation	28,411	4,292	31,853	3,966			20,606	3,205
4 34-Eligible Wild, Scenic River (C)					10,885	3,221		
4.4-Eligible Recreational River (A)	3,556	1,643						
4.8-Ski-based Recreation (C)					7			
5.0-General Forest and Rangelands (C)					279,459	15,012		
5.11-General Forest and Intermingled Rangelands	55,346	2,034	43,594	1,749			36,820	1,494
5.13-Forest Products	40,262	3,018	37,369	2,202			31,174	2,187
5.41-Deer and Elk Winter Range	90,986	4,057	130,710	6,444			115,046	5,809
5.42-Bighorn Sheep (A)	24,734	3,134						
6.6-Grassland Resource Production	40,773	789	34,234	335			12,993	152
8.22-Ski-based Recreation[1]	15	0	7				4	0

[1]Research natural areas and ski-based recreation management areas restrict grazing. Portions of the Hot Creek Research Natural Area on the Conejos Peak Ranger District do allow grazing under stipulations.

Recommended Wilderness

Alternatives B and D include Management Area 1.1a – Recommended Wilderness. Generally, these acres currently are designated as backcountry and Colorado roadless. The distribution of wilderness, backcountry, and roadless acreage is listed by alternative in Table 15.

Table 15. Changes in management area distribution related to recommended wilderness, by alternative

[Reported in acres]

Management Areas	Alternative A	Alternative B	Alternative C[1]	Alternative D
Management Area 1 – Wilderness			392,139	
Management Area 1.1 – Wilderness		392,139		392,139
Analyzed Wilderness 1.1a – Recommended Wilderness		58,669		284,853
Management Area 1.11 – Wilderness-Pristine	136,544			
Management Area 1.12 – Wilderness-Primitive	171,335			
Management Area 1.13 – Wilderness Semiprimitive	84,210			
Management Area 3 – Roadless			498,240	
Management Area 3.5 – Roadless	0	155,744		90,198
Management Area 3.6 – Upper Tier Roadless	0	329,977		124,033
Management Area 3.3 – Backcountry	464,282			16,927

Proposed National Wild, Scenic, and Recreational Rivers

Suitable and eligible river segments considered for inclusion in the National Wild and Scenic Rivers System are listed in Table 16.

Table 16. Suitable and eligible river segments considered for inclusion in the National Wild and Scenic Rivers System

[Note: Management of river segments on Medano and Little Medano Creeks has been transferred to the National Park Service per the Great Sand Dunes National Park and Preserve Act of 2000; NA, not applicable.]

Stream or River Name	Length (miles)[1]	Acres	Status	Outstandingly Remarkable Values	Classification
Archuleta Creek	5.69	1,889	Eligible	Scenic, Recreational	Scenic
Deadman Creek	3.26	1,087	Eligible	Scenic, Recreational, Historic, Biological	Scenic
East Fork Rio Chama	3.18	1,078	Eligible	Scenic, Recreational	Scenic
Hansen Creek	6.72	2,067	Eligible	Scenic, Recreational	Wild
Lower Rio de los Pinos	4.50	1,364	Eligible	Scenic, Recreational, Historic	Scenic
Lower Rio Grande	4.42	1,081	Eligible	Scenic, Recreational, Historic	Recreational
Rio Grande (Box Canyon)	8.73	2,720	Eligible	Scenic, Recreational, Historic	Scenic
Saguache Creek	8.40	2,478	Eligible	Scenic, Historic, Cultural	Wild
Toltec Creek	2.88	525	Eligible	Scenic, Recreational, Historic	Wild
West Bellows Creek	6.31	2,065	Eligible	Scenic, Recreational, Geologic	Scenic
West Fork Rio Chama	4.81	1,239	Eligible	Scenic, Recreational	Scenic
South Fork Rio Grande					
South Fork Rio Grande (above Big Meadows Reservoir)	5.19	1,633	Eligible	Scenic, Recreational, Historic	Scenic
South Fork Rio Grande (below Big Meadows Reservoir)	11.98	3,016	Eligible	Scenic, Recreational, Historic	Recreational
South Fork Rio Grande Total	**17.17**	**4,649**	NA	NA	NA
Conejos River					
El Rito Azul	3.80	1,168	Suitable	Scenic, Recreational, Wildlife	Wild
North Fork Conejos River	3.93	1,208	Suitable	Scenic, Recreational, Wildlife	Wild
Middle Fork Conejos River	4.59	1,411	Suitable	Scenic, Recreational, Wildlife	Wild
Conejos River (Three Forks to Platoro Reservoir)	3.33	1,023	Suitable	Scenic, Recreational, Wildlife	Wild
South Fork of the Conejos River	12.76	3,985	Suitable	Scenic, Recreational, Wildlife	Wild
Conejos River below Platoro Reservoir	12.54	3,539	Suitable	Scenic, Recreational, Wildlife	Recreational
Conejos River Total	**40.95**	**12,334**	NA	NA	NA
Wild Rivers Subtotal	**46.41**	**13,865**	NA	NA	NA
Scenic Rivers Subtotal	**41.67**	**13,075**	NA	NA	NA
Recreational River Subtotal	**28.94**	**7,636**	NA	NA	NA
Rio Grande National Forest Total	**117.02**	**34,576**	NA	NA	NA

[1] Length, in miles, of the reaches has been updated from the 1996 forest plan revision to reflect the best available information; changes do not reflect alterations to the eligible or suitable river segments.

Proposed Special Area Designations

Acreage of proposed Forest-designated special areas including research natural areas, special interest areas, wild, scenic, and recreational rivers, congressionally designated trails, scenic byways and railroads, and other specially designated areas for each alternative is shown in Table 17. For more information about existing and proposed special designated areas, see *Designated and Proposed Special Interest and Research Natural Areas* in Chapter 3. Maps of *Special Designated Areas for Alternatives A through D* are contained on the DVD located at the back of this document.

Table 17. Acreage of special interest areas and designated areas, by alternative

Management Areas	Alternative A (acres)	Alternative B (acres)	Alternative C (acres)	Alternative D (acres)
Management Area 2.2 – Research Natural Area	23,868	23,868		25,154
Management Area 3.1 – Special Interest Area	34,666	26,966		148,920
Management Area 3.3 - Backcountry	464,282			16,927
Management Area 3.4 – Eligible and Suitable Wild, Scenic, and Recreational Rivers	10,133	35,872		35,872
Management Area 4.1 – Special Designation: Special Interest Area			26,096	
Management Area 4.2 – Special Designation: Research Natural Area			23,798	
Management Area 4.21 – Scenic Byway and Railroad	27,487	27,487	27,487	27,487
Management Area 4.23 – Special Designation: Congressionally Designated Trail				83,997
Management Area 4.34 - Eligible and Suitable Wild, Scenic, and Recreational Rivers			35,872	
Management Area 4.4 – Eligible and Suitable Recreational Rivers	10,809			
Management Area 4.8 – Special Designation: Ski-based Resorts			1,632	
Management Area 8.22 – Ski Based Resorts	1,632	1,632		446

Wildlife Management

Alternatives B, C, and D include revised management direction for fish, wildlife, and plant species, as well as updated, more specific direction for threatened and endangered species, and species of conservation concern, and the key ecosystem characteristics on which they depend. All action alternatives also contain revised management direction for Canada lynx in late-successional spruce-fir habitat, as well as direction for recreational dredging considering potential impacts in aquatic ecosystems. Alternative D prohibits off-road game retrieval.

For more information, see the *Wildlife and Plant Species* and *Aquatic Ecosystems* sections in Chapter 3.

Sustainable Recreation

Alternative A does not specifically account for the concept of sustainable recreation. However, many of the principles associated with sustainable recreation were present in plan direction developed in 1996. Under this management direction, the Forest's recreation program would continue without a sustainable focus for the program over the planning period.

Alternative A reflects the Forest's existing summer recreation opportunity spectrum mapped in 1996 and based on the factors considered at that time. The class designation percentages are listed in Table 18. Recreation opportunity spectrum class designations are not applied to private lands located inside the forest boundary.

Table 18. Alternative A summer recreation opportunity spectrum settings

Percent Recreation Opportunity Spectrum class designations				
Primitive	Semiprimitive nonmotorized	Semiprimitive motorized	Roaded natural	Rural
8	43	28	20	1

Desired summer recreation opportunity spectrum classes for alternatives B, C, and D are summarized in Table 19. These three alternatives contain revised plan direction to help achieve sustainable recreation and address recreation settings, opportunities, and access for nonmotorized, motorized, developed, and dispersed recreation opportunities. This revised direction would help the Forest keep and re-evaluate which facilities and trails would be maintained and connected, and would focus all management decision on resource benefits.

Table 19. Alternatives B, C, and D desired summer recreation opportunity spectrum classes

Alternative	Percent Recreation Opportunity Spectrum class designations[1]				
	Primitive	Semiprimitive nonmotorized	Semiprimitive motorized	Roaded natural	Rural
B	7	44	28	20	1
C	7	33	36	23	1
D	36	19	25	19	less than 1

[1] Recreation opportunity spectrum class designations are not applied to private lands located inside the Forest boundary.

Total nonmotorized and motorized opportunities by combined recreation opportunity spectrum class percentages across all action alternatives are listed in Table 20. The nonmotorized recreation opportunity spectrum classes (primitive and semiprimitive nonmotorized) are the highest under alternative D because of increased acreage of recommended wilderness.

Table 20. Nonmotorized and motorized settings

Alternative	Total Nonmotorized (percent)	Total Motorized (percent)
A	51	49
B	51	49
C	40	60
D	55	45

For more information and analysis on this subject, see the *Sustainable Recreation Opportunities* section in Chapter 3.

Chapter 3. Affected Environment and Environmental Consequences

This chapter summarizes the physical, biological, social, and economic environments of the project area and the effects of implementing each alternative on that environment. It also presents the scientific and analytical basis for the comparison of alternatives presented in Chapter 2.

The analysis of alternatives addresses changes in forest plan direction across the alternatives. The analysis addresses impacts on overall programs. Forest plan direction is included in the Rio Grande National Forest Draft Revised Land Management Forest Plan and can be referenced there.

Nature of the Analysis

This analysis takes a programmatic look at the outcomes that may result from implementing the proposed management direction in each alternative. Estimating effects at the programmatic forest-plan level makes assumptions that the types of resource-management activities allowed under the prescriptions are reasonably foreseeable future actions to achieve the goals and objectives stated in the forest plan. However, the specific location, design, and extent of such activities are generally not known. Those decisions are made on a site-specific basis in compliance with the forest plan. Therefore, the discussions here refer to the potential for the effect to occur at the programmatic level.

The forest plan does not prescribe site-specific projects; therefore, potential spatial and temporal effects cannot be attributed to a specific area and the analysis contains no direct effects analysis. Because no commitments regarding site-specific actions are made, there are no irreversible and irretrievable commitments or short-term losses of productivity included in the analysis. Cumulative effects result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions (40 CFR 1508.7). The analysis of cumulative effects provides a larger context in which to evaluate the effects of the forest plan. Cumulative effects can be described in terms of potential to generally affect trends for the overall resource. The cumulative effects of a program at the forest-plan scale can be discussed only in terms of general programmatic tendencies toward either improved or declining resource condition.

Other Required Disclosures

The Forest has been in communication and consultation with the following agencies and tribes:

- U.S. Fish and Wildlife Service under the Endangered Species Act for changes to the Southern Rockies Lynx Amendment since January 2017.
- Colorado State Historic Preservation Office through plan development for adherence with the National Historic Preservation Act.
- Colorado Department of Natural Resources for integration of the Colorado Roadless Rule.

- The Navajo Nation as a cooperating agency.
- Nineteen tribes affiliated with the Forest: the Southern Ute Tribe, Ute Mountain Ute Tribe, Uintah and Ouray Ute Tribe, Jicarilla Apache Nation, Comanche Nation, Navajo Nation, Pueblo of Taos, Pueblo of Picuris, Hopi Tribe, Pueblo of Santa Ana, Pueblo of Santa Clara, Pueblo of Ohkay Owingeh, Cochiti Pueblo, San Ildefonso Pueblo, Pueblo of Laguna, Pueblo of Acoma, Pueblo of Santo Domingo, Pueblo of Zuni, and Pueblo of Nambe.

Air Quality

Overview

Air quality is recognized as an important resource to protect on national forests. The public values the clean air and sweeping vistas that national forests provide. Air quality affects forest resources such as aquatic organisms, cultural resources, forest health, recreation, social and economic resources, water quality, wildlife, and scenic resources. By measuring the effects of air pollution on these resources, the extent of degradation to the Forest can be measured. Air regulators, land managers, and concerned citizens can use this information to promote improvements in air quality that will benefit national forest areas and the people who visit them.

A detailed overview of air quality on the Forest is contained in Assessment 2 – Air Quality, Soils, and Water Resources (USDA Forest Service 2016), portions of which are included in the section below.

Air pollution affects the natural quality of forest lands, particularly wilderness areas. Impacts can include injury to sensitive vegetation, lake body acidification, eutrophication, hypoxia, and soil nutrient changes. Deposition of toxic metals can harm aquatic and terrestrial ecosystems. Visibility may also be impaired by the haze that results from suspension of fine particulates in the air. The air pollution that affects national forests comes from many sources, large and small, located nearby and far away. Common sources include emissions from industry, motorized vehicles, wood burning stoves, mining, and road construction. The pollution typically originates outside of national forest boundaries but is transported through the atmosphere and deposited inside national forest boundaries, but can also originate within forest boundaries.

The impact on the ecosystem is related to the types and amount of pollution emitted, the distance from the ecosystem of concern, and the atmospheric conditions, such as weather, affecting the transport and dispersion of pollutants. The ecological effects of air pollution may also vary by location, time, and sensitivity of individual species. The response of an ecosystem to air pollution is dependent not only on the amount of contaminants to which it is exposed, but also on the ability of the ecosystem to buffer itself against the effects of air pollution. Hence, understanding and monitoring for air quality values in a national forest requires a comprehensive view, combined with local knowledge.

Wilderness air quality values are those properties of wilderness that are affected in some way by air pollution and include visibility, odor, flora, fauna, soil, water, geologic features, and cultural resources. Mandatory Class I areas were designated by Congress and receive special protection under the Clean Air Act. These include wilderness areas larger than 5,000 acres that were in existence (or authorized) on August 7, 1977. Class I area values are called air quality related values and are protected under the Clean Air Act. Class II area (established after 1977) values are called wilderness air quality values. The Forest Service is required to protect air quality values within both Class I and Class II areas. Air quality values are monitored using sensitive receptors and indicators and by critical targets and loads Sensitive receptors and indicators are properties or features, such as high-altitude lakes, lichens, and vistas that may be affected by air pollution. Critical loads are quantitative estimates of levels below which no harmful impacts are expected but where exceeding those levels will affect a specified feature or property within the wilderness ecosystem.

These sensitive receptors are the specific components of an ecosystem through which change in air quality or wilderness air quality-related values are quantified. Sensitive receptors are selected for known or suspected sensitivity to pollutants, availability for manageable, cost-effective monitoring, sampling, and analysis methods, and relevance for modeling capabilities. The relationship between air pollution and effects on individual components of the wilderness is influenced by a component's ability to resist displacement from its natural condition, ability to recover from an individual human-caused event, and the number of times the wilderness component can return to the natural condition after repeated human-caused change incidents.

In addition to emitting carbon monoxide, particulate matter, and hazardous air pollutants, fossil fuel burning emits sulfur dioxide and nitrogen oxides into the atmosphere. Certain types of agricultural activities emit ammonia to the atmosphere. Such emissions can lead to atmospheric deposition of sulfuric acids, nitric acids, and ammonium to forest ecosystems. In sensitive ecosystems, acid compounds can acidify soil and surface waters, thereby affecting nutrient cycling and ecosystem services. In more resilient ecosystems, nitrogen deposition can lead to chemical and biological changes through nitrogen saturation, which can then affect ecosystem services. To address whether atmospheric deposition is having negative effects, critical loads are calculated. If monitoring and modeling indicate that critical loads are being exceeded, then target loads are established.

Critical loads are quantitative estimates of exposure to one or more pollutants below which significant harmful effects on sensitive elements of the environment, according to present knowledge, are not expected to occur. Values are scientifically determined based on expected ecosystem response to a given deposition level. The environmental effects can extend over great distances when values are exceeded. Target loads are acceptable pollution loads or levels agreed upon by policy makers and land managers. Acceptable target loads are based on the economic costs of emissions reductions, timeframes, and other matters.

Affected Environment, Existing Conditions, and Trends

A detailed discussion of the affected environment is contained in Assessment 2 – Air Quality, Soils, and Water Resources (USDA Forest Service 2016), which also includes a more extensive discussion of existing conditions and trends.

Air quality must be considered at a regional (airshed) scale and also must be considered to some extent at a global scale. An airshed is a geographical area where local topography and meteorology limit the dispersion of pollutants away from the area. Airsheds typically are identified as a geographic boundary for air quality assessments. The Forest is in the Cañon

City airshed (USDA Forest Service 1994), a large geographical area in south-central Colorado, with the Continental Divide on the western side. The Continental Divide exerts considerable control over the air currents and circulation within this airshed. Prevailing upper level winds are from the southwest and west (Mast et al. 2005), with occasional shifts due to cold fronts. Regionally, areas in northwestern New Mexico and southwestern Colorado and Utah have some impact on the area because of the industries that are prevalent in the area, such as oil and gas development, power generation, and industrial stack emissions.

Stationary sources of pollution include facilities such as those used for energy production, mining and milling operations, gravel and cement plants, and ski areas. Areas directly affected by these facilities are typically confined to a radius of tens of kilometers downwind of the facility. Large stationary sources, typically facilities that produce more than 100 tons per year, can impact national forest areas in excess of 300 kilometers downwind by contributing to pollutant haze layers. Emissions information is generally tracked for pollutants that have health-based air quality standards such as carbon monoxide, nitrogen oxides, sulfur dioxide, and particulate matter.

Stationary sources of air pollution within a 100-kilometer (62-mile) radius of Monte Vista, Colorado, which serves as a good centroid for the Forest and its associated sub-airshed, can be queried (Colorado Department of Public Health and Environment 2017). These sources were determined to be in the central, north-central, south-central, and southeastern parts of the San Luis Valley. Area and mobile sources include motorized vehicles, agricultural activities, planes, trains, residential wood burning, lawn mowers, barbeques, wind-blown dust, and smoke from wildfires and agricultural ditch burning. Data for upwind sources of emissions beyond the 62-mile limit of the State of Colorado also can be queried (U.S. Environmental Protection Agency 2017a). Upwind areas that contain facilities that could potentially affect air quality in the Forest include a large area south of Durango, Colorado, and east of Farmington, New Mexico, and a concentrated area around Spanish Peaks west of Trinidad, Colorado. Facilities in these areas are associated primarily with energy use and development. Other potential sources include areas around and south to southeast of Phoenix, Arizona, and the Los Angeles metropolitan area in California.

Primary sources for carbon monoxide include wood combustion, motorized vehicles, and non-road engines; for nitrogen oxides: power plants, vehicles, non-road engines, oil and gas development, wood combustion, and railroads; for sulfur dioxide: wood combustion, vehicles, oil and gas, and non-road engines; for particulate matter: wood combustion, road and trail dust, agriculture tilling, and construction; and for volatile organic compounds: oil and gas development, pesticides, wood combustion, non-road engines, and vehicles.

Wildfires can be a visibly noticeable source of air quality impact due to aerosols including organic and elemental carbon and particulate matter. Impacts from wildfires are increasingly difficult to predict and manage due to fuel loads, fire exclusion history, increasing wildland-urban interfaces, and climate change. Fuel treatment practices, including fire and mastication, would continue in an effort to reduce the size, frequency, and intensity of wildfires to improve fire control and increase the predictability of fire effects.

Air emission information provides an overview of the magnitude of air pollution and is important in understanding air quality on the Forest. Trends in precursor emissions would be expected to track with trends on the Forest, such as visibility and acid deposition.

Overall, air quality within and near the Forest is good to excellent as the area is minimally developed, has limited local emissions sources, and has predominantly very robust air dispersion (see Assessment 2). Wildfire emissions, depending upon the year, can be the most significant source of pollution within and around the Forest, but are not controllable by management except indirectly, through fire suppression. Prescribed-fire emissions in the area commonly occur during the spring and late fall. The amount of activity is expected to hold constant, with a few hundred to several thousand acres per year being treated. Smoke management is regulated by permit from the State of Colorado. Overall smoke emissions from wildland fire are expected to remain about the same, with the major variable being weather conditions.

Dust generated by winds blowing across the San Luis Valley also impacts the air quality of the Forest, particularly in the Sangre de Cristo Mountains. Dust generated in the southwestern United States and at a global scale also impacts the Forest, most noticeably as a dark covering on top of the snowpack as it melts in the spring.

The greatest threat to air quality within the Forest is from upwind anthropogenic sources. Upwind urban and industrial air pollution, although low to moderate when compared with much of the United States, has a potentially persistent impact because many of these emissions occur year-round. These sources are managed by the air quality regulatory agencies in Colorado and upwind states, with collaboration from the Forest Service for major sources permitting through the prevention of significant deterioration process. Currently, as previously discussed, all Colorado communities are in attainment of all National Ambient Air Quality Standards, with the exception of the Front Range ozone control area, which is in non-attainment for the 8-hour ozone standard. Ozone has been in decline regionally since at least 1980 (U.S. Environmental Protection Agency 2017b), and particulate matter has also been in decline (U.S. Environmental Protection Agency 2017c).

In the past there were several communities across the state in non-attainment for violation of one or more of the Federal clean air standards. Implementation plans have since been developed for these communities that show how these communities have attained and will maintain compliance with the standards. The closest community to the Forest under one of the maintenance plans is Pagosa Springs, for particulate matter less than 10 microns.

The largest upwind anthropogenic source of air quality concern on the Forest is energy development in southwestern Colorado and northwestern New Mexico, and perhaps the Spanish Peaks area west of Trinidad, Colorado. Continued compliance with National Ambient Air Quality Standards and protection of Class I and II areas on the Forest requires continued close coordination between the Forest Service and air quality regulatory agencies in Colorado and upwind states.

A considerable amount of historic and current air quality monitoring data is available for tracking air quality conditions and impacts to air quality values. Interagency Monitoring of Protected Visual Environments (2017) sites for the Weminuche Wilderness and Great Sand Dunes National Park are useful for visibility monitoring. Since 1985, monitoring has been conducted at these interagency monitoring sites to establish visual conditions and track changes over time. The Colorado “scenic and important views” database is useful for prevention of significant deterioration permitting efforts the Forest may become engaged with in the future. Historic and on-going lake water chemistry data are useful for tracking atmospheric deposition in terms of acid rain and nutrient loading. U.S. Geological Service snowpack chemistry data and national atmospheric deposition program deposition data collected from surrounding areas are useful for atmospheric deposition monitoring.

Haze indices indicate that visibility on the clearest days is improving over time, but there is no apparent trend in the index on the haziest days. Episodic wind events and associated dust appear to be affecting visibility on the Forest, particularly in the Sangre de Cristo Mountains. Regional and global wind driven dust also appear to be affecting visibility. Data collected from high-elevation lake monitoring indicate there are lakes sensitive to atmospheric deposition in the Weminuche and South San Juan Wilderness Areas but not in the La Garita and Sangre de Cristo Wilderness Areas. These data sets are presently being analyzed for trend, but the results may or may not be available for the current revision effort. Snowpack chemistry monitoring indicates no apparent trend with nitrate concentrations, an apparent downward trend with sulfate concentrations, and a slight upward trend with ammonium and mercury concentrations. National Atmospheric Deposition Program site data indicate an apparent downward trend in sulfate concentration and deposition, apparent downward to no trend to upward trend in nitrate concentration and deposition depending upon location, and apparent upward trend in ammonium concentration and deposition.

The critical load assessment indicates potential concern with nitrogen deposition on lichens, soil quality, and vegetation, particularly in the alpine habitats. Monitoring in the Class I Weminuche and La Garita Wilderness Areas may be beneficial to measure the extent to which potential effects have occurred. Until additional information becomes available that disputes or supports the results of the critical load assessment, the Forest does not need to establish refined critical loads and target loads at this time; rather, the Forest should continue with development, adjustment, and implementation of its existing air resources program.

The nearest active ozone monitoring site to the Forest is Shamrock Mine (see Assessment 2), which was established in 2004. The Forest Service and State of Colorado monitor ozone at multiple rural, high-elevation sites across the southern Rocky Mountains. Musselman and Korfmacher (2014) recently summarized these data. The authors noted that many of these locations have, on occasion, ozone concentrations that exceed the current standards but that there are significant year-to-year differences, that concentration levels are primarily in the mid-concentration range, and that the small daily fluctuations indicate overall stable concentrations.

The Forest Service uses the watershed condition framework to characterize the health and condition of National Forest System lands. The characterization is a reconnaissance-level approach using a set of 12 indicators and 24 attributes that are surrogate variables representing ecological, hydrologic, and geomorphic functions and processes that affect watershed condition (USDA Forest Service 2011). One attribute within the Forest Health indicator is ozone. This attribute is rated to address forest mortality impacts to hydrologic and soil function due to air pollution. All watersheds on the Forest were rated “functioning properly” relative to ozone. Two other attributes, water quality and soil contamination, were rated in part using data related to air quality.

The Air Quality Portal for Land Management Planning (USDA Forest Service 2017) provides guidance on assessing critical loads of air pollution to determine if concerns exist with acidification, and nutrient loading, of several ecosystems components (air quality). This procedure was followed during Assessment 1 of this planning process and it was determined that exceedance of critical loads occurred at certain lakes but buffering due to geologic materials and soils should mitigate any concerns. There are small lakes in the Weminuche and South San Juan Wilderness Areas with low acid neutralizing capacity where localized geologic materials and soil may not provide adequate buffering. Thus, current lake monitoring efforts should continue and trend monitoring should be conducted.

Assessment 1 and 3 – Ecosystem Integrity, Systems Drivers and Stressors for Terrestrial Ecosystems indicates that the extent and severity of exceedance for mycorrhizal fungi is low and thus not a concern. Because exceedances of the lichen critical loads fall within the realm of uncertainty, lichen monitoring in the Class I Weminuche and La Garita Wilderness Areas may be beneficial to measure the extent to which potential effects have occurred. Exceedances of the minimum critical loads for herbaceous plants/shrubs and forests occur across 29 percent of the Forest; and for nitrate leaching across 41 percent of the Forest. While 1.66 kilograms per hectare per year deposition identified in Assessment 2 is not particularly high, it is within the range of critical concerns. Exceedance could be indicative of a trend toward issues with lower organic soil carbon to nitrogen ratios, higher nitrogen mineralization rates, potential net nitrification rates, foliar nitrogen concentration, higher nitrogen to phosphorus, nitrogen to calcium, and nitrogen to magnesium ratios in forested areas. Changes in plant species composition in alpine ecosystems may enhance rates of nitrogen cycling or could lead to nonlinear increases in nitrate leaching and soil acidification (Pardo et al. 2011). Because ammonium deposition at two National Atmospheric Deposition Program sites in the vicinity of the Forest visually appears to be on an upward trend, soil and vegetation monitoring in the Class I Weminuche and La Garita Wilderness Areas may be desirable to measure the extent to which potential effects have occurred.

Direct and Indirect Effects

Impacts to air quality from Forest management activities include, but are not limited to, dust and engine exhaust. Activities that affect air quality are generally localized and are separated by time and also by space. Particulates from these localized impacts disperse quickly into the atmosphere and become diluted.

Localized impacts can in turn affect downwind areas cumulatively, as impacts from activities within the airshed can spread across the airshed into other areas, just as activities upwind can impact areas within the boundaries of the Forest.

Impacts to the chemistry of water in high mountain lakes can influence changes to aquatic habitat, vegetation, and scenic vistas within the boundaries of the Forest. Monitoring at the regional and Forest level would continue to allow Forest staff to gauge changes and estimate hazards to resources.

Upwind sources would continue to impact the air quality on the Forest. Management activities would have some localized impacts, possibly with some airshed-scale implications primarily from engine exhaust, dust, and smoke from prescribed burns. Wildfires would periodically impact the air quality in the region due to smoke.

Effects on Air Quality from Timber Harvest

Air quality would be impacted by timber harvest activities primarily through the engine exhaust of equipment used to prepare for, harvest, and subsequently transport forest products, along with dust from haul routes. This is primarily a localized impact, for which particulates disperse quickly and individual impacts do not have a Forestwide or regional impact. Cumulatively there is potential to combine with other activities to create impacts; however, they are unlikely to occur simultaneously, so localized impacts are reasonable to consider.

Timber suitability changes across alternatives. Alternative A, which represents current management, has approximately 320,567 suitable acres. From least to most, the other alternatives have: D – 401,414 acres, B – 468,311 acres, and C – 480,683 acres.

Timber suitability acres provide a relative basis to compare the potential impacts of timber management impacts on air quality. Relatively, alternatives A and D propose fewer available acres for timber harvest and therefore would be the most protective of air quality, and alternative C allows the most acres of timber to be potentially harvested. Projected management activities indicate that alternative C would have the greatest impact due to the higher average acres harvested, while alternative A would have the fewest acres impacted. Alternatives A and B are very similar in the amount of acres potentially impacted. Because all harvest activities would not occur at the same time or in the same location, impacts from engine exhaust and dust are similar across alternatives. Localized inputs would be realized at each location and would be analyzed in subsequent site-specific analysis. These localized impacts can cumulatively combine with other regional inputs to impact air quality at any given time, but impacts are not expected to change trends described in the current conditions and trends section of Assessment 2. Alternative C has the greatest potential to impact current and future trends, while alternative D, which has the least amount of planned management activity, would be the least likely to impact air quality.

Effects on Air Quality from Fire Management

Wildfires have the most significant impact on air quality within the boundaries of the Forest. The two most recent large fires on the Forest were the Million Fire in 2002 and the West Fork Complex Fires in 2013. Both impacted air quality locally and also regionally. Similar large fires elsewhere in the Western United States have impacted air quality on the Forest and in the San Luis Valley. These events have the largest impact on the air quality and the least amount of control by Federal agencies.

Fire management activities contribute to air quality impacts. Smoke from prescribed burns and pile burning add particulates and other pollutants into the air. These fires are generally locally impactful but do not impact air quality for an extended time, as the smoke disperses and does not have a lasting or concentrated effect. Project-specific analysis and plans include parameters that would limit impacts.

No significant difference to air quality is expected from the different alternatives. Similar acres of prescribed burning would continue to be attempted each year, regardless of alternatives. State laws would continue to require permits and monitor compliance. High mountain lakes and monitoring sites around the area would continue to be monitored for persistent impacts to air quality associated with local and regional activities.

Effects on Air Quality from Livestock Grazing

Livestock management would continue at very similar levels across the Forest regardless of alternative. Cattle have some impact on air quality; however, since cattle generally reside in the same airshed, impacts on a regional scale are the same regardless of where the cattle graze. Local impacts are very minimal because the cattle are not often congregated together but spread out across the landscape. No significant difference among alternatives is expected.

Effects on Air Quality from Roads and Trails

Similar to timber harvest impacts, engine exhaust is a major contributor of air quality impacts. Dust can also be a visibly noticeable addition to air quality issues. As traffic increases so do exhaust outputs and dust. These effects are localized to the area where they occur; however they can also contribute to regional air quality conditions. Impacts would not necessarily be immediately visible. Impacts from the deposition of nitrogen oxides and sulfates can have impacts to vegetation and soil and water chemistry.

Alternative D is the most likely to influence air quality in a positive manner as more restrictive management direction or areas are proposed, including areas of recommended wilderness. Alternative C is the least likely to improve or protect air quality as more opportunities for management activities are possible, which could lead to more traffic and to an increase in pollutant levels. However, the differences among alternatives is relatively small in regards to impacts to air quality. It is not anticipated that the differences among alternatives would be significant in relation to how roads and trails influence air quality.

Effects on Air Quality from Recreation

Recreation is mainly driven by the public. Visitation to the Forest would likely increase into the future. More recreationists would increase the amount of impact from motorized travel, and dust and exhaust would be the influence on air quality caused by recreation. Reducing the number of miles driven on the Forest would reduce the impacts of vehicle exhaust and dust to air quality. On the surface, alternative D seems to be the most restrictive to motorized recreation and alternative C the least restrictive. More vehicles driving a shorter distance to a trailhead, however, may have the same impact as fewer vehicles driving many miles to reach a trailhead. Generally, none of the alternatives specifically limit miles driven, the total number of campfires, or other similar air quality related impacts. There is no anticipated difference among alternatives.

Effects on Air Quality from Designation of Wilderness, Wild, Scenic, and Recreational Rivers, Research Natural Areas, Special Interest Areas, and Scenic Trails and Byways

Impacts to air quality from specially designated areas would not vary based on the type of designation. Specially designated areas generally place more restrictions on management activities than other areas, which would result in fewer impacts to air quality. These impacts would be less under alternative D. Alternative B is more protective than alternatives A and C but less protective than alternative D. Regional trends and conditions essentially negate local impacts because many of the air quality impacts to the Forest come from the upwind sources like the energy production areas in northwestern New Mexico, southwestern Colorado, and southeastern Utah, as well as communities with industry such as Durango, Colorado, and Farmington, New Mexico.

Alternative D appears to be the most protective of air quality due to an increase in designated wilderness with associated additional air quality management considerations Due to dependence on upwind conditions and activities, there is no significant difference among alternatives related to air quality and designated areas.

Effects on Air Quality from Mineral Resource Activities

Mineral extraction is anticipated to continue at similar levels as was anticipated in the 1996 forest plan, and similar to current activity levels. Local impacts from mineral extraction activities are generally from dust and engine exhaust. These impacts are minimal and small in correlation with the size of mineral extraction activity.

Mineral extraction activities do not vary significantly among alternatives; therefore, air quality impacts are not expected to vary among alternatives.

Cumulative Effects

Air quality impacts are associated primarily with anthropogenic sources. Though the impacts from these sources are not as dramatic as the impacts from a natural event, such as a large fire, they are more consistent. Upwind sources of pollutants are expected to continue at similar levels. Impacts from the energy extraction and production industry and from large cities upwind of the Forest will likely affect air quality. Air quality impacts can also be realized from forest management practices to downwind receivers. Cumulatively, upwind sources can impact downwind receptors.

Past, ongoing, and reasonably foreseeable future impacts to air quality would continue on the Forest at similar rates over the planning period. Monitoring and modeling efforts would continue to integrate knowledge and understanding of local and regional inputs to air quality standards. Cooperation among agencies and other entities would also continue so that as monitoring results become known, adjustments or changes would be made to mitigate air quality impacts across the Forest and the airshed.

Forested Ecosystems

This section addresses the forested ecosystems on the Forest. In particular, it addresses many of the key ecosystem characteristics needed for ecological integrity in these ecosystems, including the diversity of vegetation, landscape disturbances, late-successional and old forest habitats, and snags and downed woody material.

Overview

Key ecosystem characteristics are defined in the 2012 Planning Rule as the dominant ecological components that describe the ecosystems and are relevant and meaningful for addressing ecosystem condition and integrity, as well as important land management concerns. Ecosystem integrity as related to vegetation is typically assessed by considering dominant ecosystem functions, composition, structure, and connectivity. Key ecosystem characteristics are measurable (i.e., quantitatively or qualitatively) and there is some type of data or means to distinguish and describe them.

Key forest ecosystem characteristics have been identified and are listed below. Estimated differences in these key ecosystem characteristics serve as the basis for evaluation of ecological integrity and sustainability.

- **Diversity of vegetation** – Maintaining a diversity of ecosystems and structural types provides the various habitats needed by the many species that use the Forest and will help ensure resiliency in the face of environmental disturbances and changes.
- **Late-successional and old forest habitats** – Late-successional and old forest habitats are an important part of a healthy ecosystem. They tend to have forest structure elements, such as large, older trees, large snags, and multiple canopy layers, that are important to some wildlife species.
- **Snags and downed woody material** – These are essential for ecological integrity and serve a variety of purposes, such as providing valuable wildlife habitat and supporting nutrient recycling.
- **Landscape Disturbances and Patterns** – A variety of disturbance agents affect the landscape of the Forest. One indicator of ecosystem integrity is whether these disturbance processes are occurring with the same magnitude and intensity as they did historically.
- **Rare communities and special habitats** – Recognizing and protecting rare plant communities is crucial to preserving the area’s diverse natural heritage. Special habitat areas generally have a disproportionate contribution to species diversity relative to their actual size or they may be habitat for species found nowhere else.
- **Connectivity** – The ability of species to move and interact throughout a landscape can aid in its survival in general, and especially when their environment is changing. It can also help maintain genetic diversity within a species.

Most key ecosystem characteristics are discussed in this section; however, connectivity primarily discussed specifically in the *wildlife* sections.

Affected Environment, Existing Conditions, and Trends

A primary goal of forest plan direction related to vegetation is to provide for ecological integrity and sustainability, supporting a full suite of native plant and animal species, while providing for the social and economic needs of human communities. Resistance and resilience of vegetation are important concepts as they relate to integrity and sustainability of the ecosystem in the face of future uncertainties. Resistance refers to the capacity of ecosystems to tolerate disturbances without exhibiting significant change in structure and composition. Resilience refers to the ability of a system to recover from disturbance in the event that the disturbance exceeds the capacity of the system to resist changing (Holling 1973). Hereafter in this document, the concepts of resistance and resilience will be jointly referred to as “resilience.”

The key ecosystem characteristics listed earlier are the identified indicators that will be used to describe ecosystem conditions and integrity, and, considered as a whole, provide a means to address forest resilience and compare effects among alternatives.

Ecosystem Drivers and Stressors

Drivers and stressors to the ecosystems of Forest are identified in Assessment 1 and 3 – Ecosystem Integrity, Systems Drivers and Stressor for Terrestrial Ecosystem (USDA Forest Service 2016) and are hereby incorporated by reference. Identified stressors and drivers include succession, wildfire, insects, diseases, climate change, management, livestock grazing, weather-related events such as wind, droughts and floods, other natural disturbances such as beaver activity, exotic species invasion, and tree encroachment. The drivers and stressors for each particular ecosystem vary widely.

Succession is the natural change in the composition, structure, and function of an ecosystem over time during long periods without major disturbances. As trees and plants grow and compete for limited resources, the species, size, and amount of the trees and plants that compose an ecosystem change.

Insect and disease outbreaks are major ecological processes that shape forest conditions. Without the influence of "change agents" such as fire, insects, and disease, forest vegetation would stagnate and eventually become homogeneous, which would decrease biodiversity and resilience to disturbance. These change agents are an integral part of forest ecosystem processes, but still pose a challenge to forest management.

Climate change affects ecological conditions through shifts in precipitation and temperature and can result in more visible effects from changes to the rate of disturbances such as wildfires and insect outbreaks. Related to this are the weather-related stressors such as droughts and floods that may be more common with a changing climate (Dale et al. 2001, Walther et al. 2002, IPCC 2014).

As the climate warms and precipitation patterns change, changes in reproductive success, growth rates, competitive environments, and disturbances will likely alter the distribution of forest types and mixtures of species across the landscape (Battaglia 2017a). Future climate projections for the Forest suggest that temperatures will get warmer throughout all the seasons and snowmelt will occur earlier in the spring (Battaglia 2017a, Talbert et al. 2016). Precipitation projections are highly variable with some models showing an increase in precipitation and others showing a decrease in precipitation (IPCC 2014).

Changes in temperature will change the growth of tree species (Rondeau et al. 2012, Vose et al. 2012, Battaglia 2017a), and this change may vary based on the particular species. Battaglia (2017a) suggests that longer growing seasons can potentially be beneficial for tree growth if moisture availability does not decrease. Earlier snowmelt can lead to increased potential for seedlings to experience frost damage and exposure to drought.

Suitable habitat for individual tree species is predicted to shift higher in elevation and northward in latitude, and it is unclear whether tree species dispersal can keep up with this movement (Vose et al. 2012). Some ecosystems are particularly susceptible to climate change-related impacts. Vulnerability assessments for the surrounding areas suggest that ecosystems adapted to warmer and drier conditions will do better than those adapted to cooler and moister conditions (Battaglia 2017a). Plant and animal species in high-elevation alpine ecosystems, such as the Uncompahgre fritillary butterfly, may be pushed to extinction if warming temperatures reduce their habitat (Alexander and Keck 2015).

Bioclimate models can be used to determine where in the future the climate will be suitable for particular tree species. Worrall et al. (2016) found that projected topoclimatically suitable areas for tree species on the Forest will shift by 2060 (Battaglia 2017a). A conservative estimate from this work shows that the potential future climate favors Gambel oak, Douglas-fir, ponderosa pine, and pinyon pine. Topoclimatic suitability for Utah Juniper, Rocky Mountain juniper, lodgepole pine, bristlecone pine, limber pine, and blue spruce is projected to be unlikely. White fir, subalpine, aspen, and Engelmann spruce lose favorable habitat. A more optimistic estimate from this work shows that the potential future climate favors Gambel oak, Douglas-fir, ponderosa pine, aspen, and pinyon pine. Topoclimatic suitability for bristlecone pine, lodgepole pine, and limber pine is still unlikely, and blue spruce is projected to lose most of its suitable habitat. Habitat loss is projected for Utah juniper, Rocky Mountain juniper, and white fir as well.

Increased tree mortality across the Western United States is already being observed due to a combination of high temperatures and drought (Worrall et al. 2008, van Mantgem et al. 2009). A reduction of forest density in terms of basal area can help improve tree resistance and resilience to drought and reduce drought-induced mortality (D'Amato et al. 2013, Bottero et al. 2016, Bradford and Bell 2016).

Rocca et al. (2014) suggests that fire risk is likely to increase in the short term (next 50 years) across all forest types. The combination of earlier snowmelt and warmer temperatures will allow longer periods for fuels to be available to burn. This will impact species differently, as tree species on the Forest have varying levels of tolerance to fire.

Multi-year droughts are linked to numerous other stressors and disturbances. Not only may wildfires increase, but other disturbances as well, such as insect infestations, invasive species, flooding, erosion, and sedimentation (Vose et al. 2012).

Management activities such as timber harvest, thinning, and prescribed fire are implemented on less than 0.2 percent of the Forest annually. However, the impact to the ecosystem of these activities varies based on the intensity, the activity, and the ecosystem, not just the acreage of the activity, and generally lasts longer than simply the year implemented. In addition, the roads associated with these activities, even temporary ones, can negatively impact the Forest and its habitat.

Livestock grazing is one of the multiple uses of the Forest. Plan direction ensures that grazing is done responsibly. Historically, extensive livestock grazing practices affected not only shrublands but also dramatically influenced lower elevation forests by removing fine, herbaceous fuels that altered fire regimes (Romme et al. 2009). Grazing can also have a magnified effect on sensitive habitats, such as riparian and wetlands.

Diversity of Vegetation – Forest Composition

Ecosystems represent broad vegetation types with similar vegetation, soil, climate, and disturbance regimes. The Forest encompasses a wide variety of forested ecosystems. This variety of forested ecosystems is driven by several factors, including the elevational and topographic variability of the area. Landscape heterogeneity is one of the guiding principles of biodiversity conservation (Lindenmayer et al. 2006). Maintaining this diversity of ecosystems and structural types in these ecosystems is important as it provides the various habitats needed by the many species that use the Forest. As discussed in the forest plan goals, a natural variety of species, genetic composition, and ecological processes are also key to providing the diversity needed for resiliency in the face of environmental disturbances and changes. Diversifying age classes and structure, seral stage, and habitat classes, where appropriate, will provide benefits including, but not limited to, providing resilience to insect and disease outbreaks, responsiveness to anticipated changes in climate, ecosystem services, recreation, increased social and economic benefits, and more (Thompson et al. 2009).

The forested and nonforested ecosystems generally vary by elevation, with the highest elevation being the alpine tundra that occurs at or above 11,500 feet in elevation. The Rocky Mountain alpine turf ecosystem is widespread above the upper timberline. Dominant species include boreal sagebrush, several sedge species, tufted hair grass, fescue grasses, Ross' avens, Bellardi bog sedge, cushion phlox, and alpine clover.

Decreasing in elevation is the spruce-fir forest, which is generally inhabited by Engelmann spruce and subalpine fir mixed with quaking aspen. Vegetation in these ecosystems has been significantly altered by the recent spruce bark beetle infestation, with an estimated 610,000 acres affected as of 2016 (USDA Forest Service GSC 2016).

The mixed conifer-wet ecosystem occurs in the transition zone between the higher elevation spruce-fir and the drier mixed conifer type. It is generally dominated by Douglas-fir and various combinations of aspen, white fir, Colorado blue spruce, Engelmann spruce, or subalpine fir with incidental occurrences of ponderosa pine.

The mixed conifer-dry ecosystem sites are generally dominated by ponderosa pine and include a mix of other species, including Douglas-fir, white fir, Colorado blue spruce, and smaller amounts of aspen. Sometimes this type is subdivided into a warm dry (high ponderosa pine component) and cool-dry (can include limber pine and bristlecone pine, along with small amounts of pinyon pine and/or juniper at lower elevations) local types to characterize the variability that occurs across the Forest.

Closer to the San Luis Valley and lower in elevation, the pinyon-juniper woodland ecosystem includes pinyon pine, Rocky Mountain juniper, and Utah juniper. These woodlands generally occur on warm, dry sites on mountain slopes, mesas, plateaus, and ridges. Understory species include sparse perennial grasses, annual and perennial forbs, and sparse shrubs.

A small component of the Forest, the Rocky Mountain Gambel oak and mixed montane shrubland ecosystem is present at the north end of the San Luis Valley near Poncha Pass. Dominant species include Gambel oak, serviceberry, sagebrush, and various other shrubs, grasses, and forbs.

The Southern Rocky mountain montane subalpine grassland ecosystem includes Thurber fescue, Arizona fescue, and several other grasses, forbs, and sedges.

The Rocky Mountain riparian ecosystem includes numerous riparian types in the upper montane/subalpine zones. These systems are highly variable and generally consist of cottonwoods, willows, sedges, and other herbaceous vegetation, aspen, and conifers such as blue spruce, Engelmann spruce, and subalpine fir. Although this type only covers a small portion of the Forest, it has high importance with regards to biodiversity due to the many wildlife species that are associated with it.

The sagebrush shrubland ecosystem is a dry shrubland type that occurs mostly adjacent to the Forest. Sagebrush shrublands are dominated by several different sagebrush species and other shrubs.

The Intermountain Basins greasewood flat ecosystem is a dry shrubland system dominated by greasewood and also includes saltbush and sagebrush species. It occupies substantial areas at low elevations mostly adjacent the Forest.

The distribution of the forested and nonforested ecosystems is listed in Table 21. A more detailed description of each of the terrestrial ecosystems is contained in Assessment 1 and 3 – Terrestrial Ecosystems (USDA Forest Service 2016).

Table 21. Forested and nonforested ecosystems, as described in the assessment reports

Ecosystem	National Forest System Acres	Percent
Spruce-Fir Forest Mix	929,645	54
Mixed Conifer-Wet	42,718	2
Mixed Conifer-Dry	94,925	5
Rocky Mountain Alpine Turf	191,800	11
Pinyon-Juniper Woodland (includes low-elevation grasslands)	100,070	6
Rocky Mountain Gambel Oak - Mixed Montane Shrubland	1,224	Less than 1
Southern Rocky Mountain Montane-Subalpine Grassland	304,136	18
Rocky Mountain Montane Riparian	61,932	4
Sagebrush Shrubland	5,014	Less than 1
Intermountain Basins Greasewood Flat	128	Less than 1
Total	1,731,592[1]	100

[1] Excludes areas that have snow, rock, or other non-vegetated cover.

In addition to the ecosystems described above, another finer-scale classification system often used by the Forest classifies areas by their dominant vegetation following regionally consistent protocols. This classification by the local cover type is what is mapped in corporate vegetation databases and often used for monitoring and tracking of accomplishments. A crosswalk between the ecosystems defined above and used in the assessments with the local cover types used in some other sections of this report is contained in Table 22. The current distribution of the local cover types is presented in Table 23 and in the *Dominant Local Vegetation Type* map, which is contained on the DVD that is included at the back of this document. Dominant vegetation types include spruce-fir (29 percent), mountain grasslands (18 percent), aspen (16 percent), mixed-conifer (12 percent), and alpine (7 percent).

Table 22. Crosswalk between the ecosystems and FSVEG Spatial local cover types

Ecosystem	Local Cover Type in FSVEG Spatial
Spruce-Fir Forest Mix	TSF (Spruce-Fir Forest) TAA (Aspen Forest) TAA-SW (Aspen Forest with Softwoods present) TLP (Lodgepole Pine Forest)
Mixed Conifer-Wet	TMC-CM (Mixed Conifer Forest – Cool-Moist) TAA (Aspen Forest) TAA-SW (Aspen Forest with Softwoods present)
Mixed Conifer-Dry	TMC-WD (Mixed Conifer Forest – Warm-Dry) TPP-PP (Ponderosa Pine Forest) TMC-CD (Mixed Conifer Forest—Cool-Dry) TBC_LI (Bristlecone Pine/Limber Pine Forest)
Rocky Mountain Alpine Turf	ALP (Alpine Vegetation)
Pinyon-Juniper Woodland (includes low elevation grasslands)	TPJ (Pinyon-Juniper Woodland)
Rocky Mountain Gambel Oak - Mixed Montane Shrubland	MT_SHR (Mountain Shrubland) DS_SHR (Semi-Desert Shrubland) UP-SWI (Non-Riparian Willow)
Southern Rocky Mountain Montane-Subalpine Grassland	MT_GRA (Mountain Grassland) DS_GRA (Semi-Desert Grassland)
Rocky Mountain Montane Riparian	RIP (Riparian Vegetation)
Sagebrush Shrubland	SSA (Sagebrush Shrubland)
Intermountain Basins Greasewood Flat	N/A

Table 23. Percentage of forested and nonforested ecosystems (FSVeg Spatial March 2017)

[<, less than]

FSVeg Spatial Local Vegetation Type	Percent
Alpine Vegetation	7
Semi-Desert Grassland	1
Mountain Grassland	18
Mountain Shrubland	<1
Riparian Vegetation	4
Sagebrush Shrubland	<1
Aspen Forest	4
Aspen Forest with Softwoods present	12
Bristlecone Pine/Limber Pine Forest	1
Lodgepole Pine Forest	2
Mixed Conifer Forest – Cool-Dry	2
Mixed Conifer Forest – Cool-Moist	8
Mixed Conifer Forest – Warm-Dry	2
Pinyon-Juniper Woodland	2
Ponderosa Pine Forest	2
Spruce-Fir Forest	29
Non-Riparian Willow	<1
Water, Rock-Bare Soil, and Unknown	6

Diversity of Vegetation – Structure

Vegetation on the Forest is typically classified into habitat structural stages developed by Forest Service Rocky Mountain Region staff (Table 24). The distribution of the habitat structural stages across the Forest is presented in Table 24, Table 25, Table 26, and in the *Vegetation Habitat Structural Type* map, which is contained on the DVD that is included at the back of this document. A large proportion of the spruce-fir vegetation type is in the 1T/2T stage. These are mostly areas that are regenerating after the spruce beetle outbreak. Accordingly, there is also a relatively low amount in the 4B and 4C classes. The mixed-conifer vegetation types tend to have a higher proportion in the mature 4B and 4C stages.

Table 24. Definition of habitat structural stages used to characterize ecosystem condition

[--, no data; DBH, diameter at breast height]

Habitat Structural Stage	Size Class	Tree Canopy Cover (percent)
1M – Natural Meadow	--	--
2S – Natural Shrubland	--	--
1T/2T – Grass/Shrub, Previously Trees	all	0 to 10
3A – Sapling-Pole 10 to 40 percent cover	sapling-pole (0–9 inches DBH)	10 to 40
3B – Sapling-Pole 40 to 70 percent cover	sapling-pole (0–9 inches DBH)	40 to 70
3C – Sapling-Pole greater than 70 percent cover	sapling-pole (0–9 inches DBH)	Greater than 70
4A – Mature 10 to 40 percent cover	mature (9+ inches DBH)	10 to 40
4B – Mature 40 to 70 percent cover	mature (9+ inches DBH)	40 to 70
4C – Mature greater than 70 percent cover	mature (9+ inches DBH)	Greater than 70

Table 25. Current percentage of acres on the Forest in each habitat structural stage (FSVeg Spatial data layers, March 2017)

Habitat Structural Stage	Percent
1M – Natural Meadow	30
2S – Natural Shrubland	3
1T/2T – Grass/Shrub, Previously Trees	11
3A – Sapling-Pole 10 to 40 percent cover	10
3B – Sapling-Pole 40 to 70 percent cover	9
3C – Sapling-Pole greater than 70 percent cover	8
4A – Mature 10 to 40 percent cover	13
4B – Mature 40 to 70 percent cover	11
4C – Mature greater than 70 percent cover	6

Table 26. Current percentage of acres in each habitat structural stage for each of the major forested types (FSVeg Spatial data layers, March 2017)

FSVEG Spatial Local Vegetation Type	Habitat Structural Stage	Percent
Riparian Vegetation	1M – Natural Meadow	65
	2S – Natural Shrubland	19
	1T/2T – Grass/Shrub, Previously Trees	0
	3A – Sapling-Pole 10 to 40 percent cover	2
	3B – Sapling-Pole 40 to 70 percent cover	2
	3C – Sapling-Pole greater than 70 percent cover	2
	4A – Mature 10 to 40 percent cover	4
	4B – Mature 40 to 70 percent cover	3
	4C – Mature greater than 70 percent cover	4
Aspen Forest	1T/2T – Grass/Shrub, Previously Trees	21
	3A – Sapling-Pole 10 to 40 percent cover	9
	3B – Sapling-Pole 40 to 70 percent cover	16
	3C – Sapling-Pole greater than 70 percent cover	35
	4A – Mature 10 to 40 percent cover	1
	4B – Mature 40 to 70 percent cover	2
	4C – Mature greater than 70 percent cover	15
Aspen Forest with Softwoods present	1T/2T – Grass/Shrub, Previously Trees	1
	3A – Sapling-Pole 10 to 40 percent cover	18
	3B – Sapling-Pole 40 to 70 percent cover	26
	3C – Sapling-Pole greater than 70 percent cover	34
	4A – Mature 10 to 40 percent cover	3
	4B – Mature 40 to 70 percent cover	8
	4C – Mature greater than 70 percent cover	11
Bristlecone Pine/Limber Pine Forest	1T/2T – Grass/Shrub, Previously Trees	6
	3A – Sapling-Pole 10 to 40 percent cover	22
	3B – Sapling-Pole 40 to 70 percent cover	13
	3C – Sapling-Pole greater than 70 percent cover	3
	4A – Mature 10 to 40 percent cover	33
	4B – Mature 40 to 70 percent cover	17
	4C – Mature greater than 70 percent cover	6
Lodgepole Pine Forest	1T/2T – Grass/Shrub, Previously Trees	1
	3A – Sapling-Pole 10 to 40 percent cover	5
	3B – Sapling-Pole 40 to 70 percent cover	22
	3C – Sapling-Pole greater than 70 percent cover	43
	4A – Mature 10 to 40 percent cover	4
	4B – Mature 40 to 70 percent cover	11
	4C – Mature greater than 70 percent cover	15

FSVEG Spatial Local Vegetation Type	Habitat Structural Stage	Percent
Mixed Conifer Forest - Cool-Dry	1T/2T – Grass/Shrub, Previously Trees	0
	3A – Sapling-Pole 10 to 40 percent cover	12
	3B – Sapling-Pole 40 to 70 percent cover	18
	3CvSapling-Pole greater than 70 percent cover	6
	4A – Mature 10 to 40 percent cover	25
	4B – Mature 40 to 70 percent cover	29
	4C – Mature greater than 70 percent cover	10
Mixed Conifer Forest - Cool-Moist	1T/2T – Grass/Shrub, Previously Trees	8
	3A – Sapling-Pole 10 to 40 percent cover	10
	3B – Sapling-Pole 40 to 70 percent cover	13
	3C – Sapling-Pole greater than 70 percent cover	8
	4A – Mature 10 to 40 percent cover	17
	4B – Mature 40 to 70 percent cover	28
	4C – Mature greater than 70 percent cover	16
Mixed Conifer Forest - Warm-Dry	1T/2T – Grass/Shrub, Previously Trees	0
	3A – Sapling-Pole 10 to 40 percent cover	6
	3B – Sapling-Pole 40 to 70 percent cover	7
	3C – Sapling-Pole greater than 70 percent cover	2
	4A – Mature 10 to 40 percent cover	34
	4B – Mature 40 to 70 percent cover	45
	4C – Mature greater than 70 percent cover	7
Pinyon-Juniper Woodland	1T/2T – Grass/Shrub, Previously Trees	1
	3A – Sapling-Pole 10 to 40 percent cover	47
	3B – Sapling-Pole 40 to 70 percent cover	35
	3C – Sapling-Pole greater than 70 percent cover	4
	4A – Mature 10 to 40 percent cover	5
	4B – Mature 40 to 70 percent cover	9
	4C – Mature greater than 70 percent cover	0
Ponderosa Pine Forest	1T/2T – Grass/Shrub, Previously Trees	8
	3A – Sapling-Pole 10 to 40 percent cover	19
	3B – Sapling-Pole 40 to 70 percent cover	3
	3C – Sapling-Pole greater than 70 percent cover	2
	4A – Mature 10 to 40 percent cover	49
	4B – Mature 40 to 70 percent cover	18
	4C – Mature greater than 70 percent cover	1
Spruce-Fir Forest	1T/2T – Grass/Shrub, Previously Trees	30
	3A – Sapling-Pole 10 to 40 percent cover	13
	3B – Sapling-Pole 40 to 70 percent cover	5
	3C – Sapling-Pole greater than 70 percent cover	1

FSVEG Spatial Local Vegetation Type	Habitat Structural Stage	Percent
	4A – Mature 10 to 40 percent cover	27
	4B – Mature 40 to 70 percent cover	17
	4C – Mature greater than 70 percent cover	5

Even though little is known about some of these ecosystems, the assessments (USDA Forest Service 2016) and published literature suggest that many ecosystems on the Forest are within the natural range of variation. The 2013 monitoring report (USDA Forest Service 2014) echoes this, "Forested lands across the Forest are generally assumed to reflect composition, structure, and pattern with a natural range of variation as described in Appendix A of the Final Environmental Impact Statement for the 1996 Revised Land and Resource Management Plan." However, some conclusions from that document included that fire suppression has had the greatest influence on lower-elevation forest and non-forest communities, that nonforested communities have probably been altered in terms of species composition due to repeated, frequent domestic livestock grazing, and that riparian areas have most likely experienced the greatest change compositionally.

Current data and research suggest that the ponderosa pine and mixed-conifer types are outside the natural range of variation. Historic stand structure in the ponderosa pine and dry mixed-conifer type was uneven-aged, heterogeneous, and less dense (Battaglia 2017b, Underhill et al. 2014). Given the more frequent fire regime of these types, they are generally thought to have been impacted by fire suppression and departed from historic conditions. Given that past management activities and disturbance events may have shifted species composition by removing the mature ponderosa pine, which led to a greater number of small-diameter and/or thin-barked late-seral trees, restoration efforts that help to move this type toward a sustainable species composition and landscape pattern where fires can function in a desirable manner are appropriate and needed. Planned management activities will help the Forest move toward or maintain the desired conditions.

Information about historical forest structure and species composition for cool moist mixed-conifer forests is limited. The mixed species present in this type would lead to very different trajectories and structures based on the disturbances that occurred. The various insect and diseases are host-specific and are not often synchronous. As a result, identifying a specific natural range of variation for this type is difficult (Battaglia 2017b). The cool moist mixed-conifer ecosystem is likely departed from the natural range of variation as a result of fire suppression and other factors, though less so than the warm dry mixed-conifer type given its less frequent fire regime. Restoration efforts are appropriate and needed in this type as well.

It is difficult to determine whether the spruce-fir ecosystem is within the range of what would occur naturally. The vegetation modeling done for the assessments suggests that the spruce-fir forest ecosystem is currently substantially departed from the natural range of variation due to the effects of recent wildfires and the large, multi-year spruce beetle outbreak. However, the determination of the range of natural conditions is not an exact science. The assessment modeling did not include the rare, extreme spruce beetle outbreaks like the one the Forest is currently experiencing, but more moderate outbreaks. Literature (Eager et al. 2012, Romme et al. 2009) suggests that these large spruce beetle outbreaks happened historically, which indicates, along with the long fire return interval in spruce-fir, that this ecosystem is not departed from historic conditions. Ultimately, it is not known with any certainty whether this latest spruce beetle outbreak is a completely natural phenomenon or if it is influenced by climate change or other factors.

Late-Successional and Old Forest

Late-successional and old forest habitats are an important part of a healthy ecosystem. They tend to have forest structure elements, such as large, older trees, large snags, and multiple canopy layers, that are important to some wildlife species, such as the American marten (*Martes americana)* and the brown creeper (*Certhia americana*).

Late-successional is defined as habitat structural stages 4B and 4C for any of the cover types (except pinyon-juniper where there is no 4C), although it is recognized that not all 4B stands have characteristics of late-successional habitat. Habitat structural stage class 4B corresponds to areas with mature trees (9 inches and larger) with 40 to 70 percent canopy cover (Table 24). Habitat structural stage class 4C corresponds to areas with mature trees (9 inches and larger) with more than 70 percent canopy cover. Old forest is defined as described in Appendix A to the draft forest plan with varying criteria based on vegetation type. Characteristics used to define old forest include age, the size of trees (dbh), the number of large trees per acre, the number of snags, the number of layers, and the amount of downed woody material.

Based on these criteria, currently about 22 percent of spruce fir and17 percent of the Forest overall is late-successional. Current amounts of late-successional habitat (Table 27) are less than the amounts estimated to be in late-successional habitat under historic conditions, based on the assessment modeling (USDA Forest Service 2016) for several ecosystems. Most forest types, other than spruce-fir and pinyon-juniper, have more late-successional habitat than desired (Table 27). If, as predicted, disturbances such as large fires and insect outbreaks increase in frequency due to climate change (Vose et al. 2012), this will have impacts on the future amount of late-successional habitat. The current amount of old forest is unknown for the Forest, but would be available at the site-specific, project level.

Table 27. Percentage of acres of forest types in late-successional habitat under current and historic conditions

Forest Type	Percentage of Successional Habitat – FSVeg Spatial March 2017	Percentage of Acres in Late-Successional Habitat
	Current Conditions	Desired Conditions
Ponderosa Pine	19	15-25
Mixed Conifer – Warm-Dry	52	25-35
Mixed Conifer – Cool-Moist	43	30-40
Mixed Conifer – Cool-Dry	39	15-20
Spruce-Fir	22	30-40
Aspen	19	-
Pinyon-Juniper Woodland	9	30-40
All (including non-forest types)	17	--

Snags and Downed Woody Material

Snags and downed woody material are essential for ecological integrity. They serve a variety of purposes, such as providing valuable wildlife habitat and supporting nutrient recycling. At least 84 terrestrial vertebrate species of wildlife rely on snags in Colorado (Hoover and Wills 1984). Snags are key for cavity-nesting species such as woodpeckers, small forest owls, bats, and small mammals. Downed woody material is important for water quality and reducing soil erosion. Large downed logs in particular are an essential habitat component for some wildlife species.

Snags and downed wood conditions are largely dependent on the pattern of natural and human disturbance processes. Dead wood components are continually created by fire, insects, disease, and mortality during the course of natural succession. Decomposition and fire are the primary ecological processes that remove, or more accurately, recycle, dead wood within the ecosystem. Vegetation treatments also remove dead wood. High amounts of dead wood occur in areas where fire, insects, or disease have occurred, with snags predominant at first, shifting to predominantly downed wood as the dead trees fall. Snags will continually be lost as they fall to the ground to become part of the downed wood component, where they will decompose and become part of the soil.

From stand exam data and forest inventory and analysis plot data collected on the Forest, the average number of large snags (generally 12 inches in diameter and larger as defined in the 1996 forest plan, although it varies by species) has increased over time, especially since the spruce beetle outbreak started. Both datasets suggest there has been a dramatic increase in the number of large snags on the Forest, from about 5 per acre to about 15 to 25 per acre.

The average snag estimates from stand exam data and Forest Inventory and Analysis Program plot data were compared to the minimum amounts recommended in the 1996 forest plan and to the minimum amounts suggested in the South Central Highlands Guide (Romme et al. 2009). Results suggest that amounts in the Forest are well above the minimum amount of snags desired for the various forest types as identified in the forest plan. The only exception to this is in the ponderosa pine forest type, where both the stand exam and forest inventory and analysis data suggest that there is currently less than the desired three snags 14 inches or larger per acre. Romme et al. (2009) states "In truth, we simply do not know densities or quantities of dead wood in the pre-1870 ponderosa pine forests of the South Central Highlands section," which makes it difficult to know if the snag amounts currently present in the ponderosa pine areas on the Forest are within natural range of variation or not.

Stand exam data were also examined for information on downed woody material, with results suggesting that the Forest has a large volume of downed woody material. The amount of downed woody material 3 inches and larger in size varies heavily by forest type and from stand to stand within a given forest type. The spruce-fir forest type has the highest levels of downed woody material 3 inches and larger, with a large amount of variation. In general, the various forest types have more than the minimum amount recommended in the 1996 forest plan. The one exception to this is the ponderosa pine type, which averaged an estimated 2.5 tons per acre, less than the 4 to 9 tons per acre suggested in the 1996 forest plan. It is difficult to know if the amount of downed wood currently present in the ponderosa pine areas on the Forest are within natural range of variation or not. A lower downed wood retention value for ponderosa pine is warranted given the frequent fire regime for this type.

In summary, as a result of the recent spruce beetle outbreak, the Forest currently has a large amount of snags and downed woody material, particularly in the spruce-fir forest type. As snags fall and downed woody material decays, these values will most likely decrease. How fast this happens will depend on the forest type and a variety of other factors. In the spruce-fir areas impacted by spruce beetle, some research suggests that snag fall will be gradual, with some of these snags still standing until about 70 years, with a fair percentage still standing at 50 years or more (Mielke 1950). Other research as well as vegetation modeling done on the Forest suggests that snag fall could be much quicker (Delong et al. 2008, USDA Forest Service 2004). Longer term, and in other vegetation types, it is hard to predict how snag and downed woody amounts may change. Disturbances such as large fires and insect outbreaks are predicted to increase in frequency due to climate change (Vose et al. 2012), in which case snags and downed woody material may be maintained into the future. Due to this uncertainty, plan components pertaining to the retention of snags and downed wood are included in the alternatives, and the results of monitoring snags into the future will indicate whether there are sufficient levels for ecological integrity and wildlife habitat.

Disturbance Processes – Insects and Disease

Several insects and diseases significantly influence forest structure and composition on the Forest. While these insects and diseases are native species and natural disturbance agents beneficial to ecosystem function and ecological conditions important for wildlife species, high amounts or outbreaks may be damaging to other habitat components or other desired uses of the Forest. There is currently heavy mortality from these disturbance agents Forestwide due to the high amount of large, older age forests, the warmer, drier climate, and the intense drought that occurred in the late 1990s and early 2000s (Eager et al. 2012).

Important insects and disease vary with elevation and vegetation type, and include:

- spruce beetle (*Dendroctonus rufipennis*),
- root-decay fungi (*Heterobasidion sp.)* and (*Armillaria* sp.),
- western balsam bark beetle (*Dryocoetes confuses*),
- mountain pine beetle (*Dendroctonus ponderosae*),
- Douglas-fir beetle (*Dendroctonus pseudotsugae*),
- western spruce budworm (*Choristoneura occidentalis*),
- western tent caterpillars (*Malacosoma sp.),*
- dwarf mistletoes (*Arceuthobium spp*.),
- pinyon ips (*Ips confuses*), and
- white pine blister rust (*Cronartium ribicola*).

The spruce beetle is a native bark beetle that inhabits all species of spruce in North America. On the Forest, Engelmann spruce is the principal host. Although beetle populations typically remain at relatively low densities, they periodically explode into an outbreak and kill most of the large-diameter trees in affected areas over thousands of hectares (Eager et al. 2012, Romme et al. 2009).

Since the early to mid-2000s, large spruce beetle outbreaks have occurred on several national forests in Colorado and Wyoming, including the Rio Grande National Forest. According to the 2013 Forest monitoring report, well over 480,000 acres of spruce-fir forest exhibit high levels of spruce beetle activity. This often results in tree mortality that meets or exceeds 90 percent of the overstory, although it is highly variable across the landscape. The 2016 aerial survey estimates increased this to 610,000 acres (USDA Forest Service GSC 2016). Although the Forest is at the epicenter of this outbreak, acres affected by spruce beetle are declining due to exhaustion of the mature spruce cover type that is the beetle's primary host (USDA Forest Service GSC 2016).

Root diseases are important in the ecology and productivity of mixed conifer and spruce-fir stands on the Forest. In spruce-fir, Armillaria root disease is typically most important, infecting both Engelmann spruce and subalpine fir. Subalpine fir may also have an outbreak of western balsam bark beetle, and is typically killed while standing. Engelmann spruce more often falls due to decayed roots while still green. Infected spruce may serve as hosts for spruce beetle during non-epidemic conditions, and strip attacks can be found above infected roots. When infected spruce fall (windthrow), they can lead to increases in spruce beetle populations. The disease generally intensifies as stands mature (USDA Forest Service GSC 2016).

In mixed conifer stands, annosus root disease (caused by *Heterobasidion occidentale*) is also important. White fir is the primary host of this disease. White fir has become more prevalent due to past selective harvesting of ponderosa pine and Douglas-fir as well as fire exclusion. As white fir has increased, so has the disease. Dense white fir stands are often severely affected. Because white fir is shade-tolerant, it is replaced by more white fir, and the disease intensifies.

The mountain pine beetle, a native insect, attacks and kills pine trees. Although the predominant host species are lodgepole pine and ponderosa pine, on the Forest, mountain pine beetle will also attack limber pine, bristlecone pine, and even pinyon pine (Eager et al. 2012). Although mountain pine beetle has received a lot of attention in the Rocky Mountain Region, the Forest has only small to moderate amounts of lodgepole, ponderosa, limber, and bristlecone pine forests and recent population levels have remained relatively low, so the effect on the Forest has not been as great as it has been region-wide.

Mountain pine beetle activity increased after the drought of the late 1990s and early 2000s, but has since declined. Suppression of wildfires over the last 100 years has had an influence on the density and age distribution of ponderosa pine stands. With fewer fires to thin stands and create openings, regeneration has become established, growing in dense, even-aged, ponderosa pine stands. Stands with these features are susceptible to infestations of mountain pine beetle.

The Douglas-fir beetle attacks and kills mature Douglas-fir trees. It prefers older and injured trees, and is most prevalent in dense stands with large trees. Douglas-fir beetle has caused noticeable mortality since the 1996 forest plan was released, especially after the drought of the late 1990s and early 2000s. Currently, mortality from Douglas-fir beetle is low to moderate, with some scattered patches of recent mortality (Eager et al. 2012, USDA Forest Service GSC 2016). A total of only 1,600 acres with Douglas-fir beetle mortality were recorded in 2016 (USDA Forest Service GSC 2016).

The western spruce budworm is the most prominent defoliating insect present in the Forest. A native species, it is the most widely distributed and destructive defoliator of coniferous forests in western North America. The budworm feeds primarily on Douglas-fir, white fir, subalpine fir, and to a lesser extent, Engelmann spruce. This insect causes defoliation of new growth throughout the canopy and understory host trees. It rarely kills its host outright, but years of defoliation can weaken trees and make them susceptible to bark beetles (Eager et al. 2012).

Western spruce budworm activity on the Forest recently declined after being at a high level (Eager et al. 2012). In 2016, 25,000 acres were defoliated by western spruce budworm (USDA Forest Service GSC 2016).

Stand conditions contribute greatly to the budworm population's ability to increase to outbreak status. Reduced fire frequency allows shade tolerant white fir and Douglas-fir populations to increase in mixed conifer stands, providing favorable habitat for western spruce budworm. Multistory stands favor western spruce budworm survival as larvae disperse from overstory trees. A history of fire exclusion and passive management has resulted in stand structures favorable to spruce budworm (Eager et al. 2012). However, tree-ring analyses are inconsistent as to whether outbreaks since the early part of the 20th century have been more extensive and damaging than outbreaks in previous decades (Swetnam and Lynch 1989, Ryerson et al. 2003).

Western tent caterpillar is the most significant defoliator of deciduous trees. The larvae feed gregariously on aspen leaves and construct silken tents in the crowns. Repeated defoliation of aspen by this insect results in branch die-back and tree mortality. When large areas of aspen die as a result of repeated defoliation, the clones fail to regenerate, causing openings or changes in forest type.

The number and size of tent caterpillar outbreaks depends on the number and size of contiguous areas of mature aspen. Assuming that historically, aspen dominated a larger portion of the forested lands, tent caterpillar outbreaks today may be smaller and less numerous than those that occurred prior to settlement.

Dwarf mistletoes cause significant growth loss, and over time can substantially impact forest productivity. Mortality can result when infestations are severe. The most important dwarf mistletoes on the Forest are southwestern dwarf mistletoe (*Arceuthobium vaginatum ssp. cryptopodum*) infecting ponderosa pine, and Douglas-fir dwarf mistletoe (*A. douglasii*), primarily infecting Douglas-fir.

Historically, fire played a major role in determining the distribution of dwarf mistletoe by affecting stand composition and sanitizing infested stands. With fire suppression, the distribution and impacts of dwarf mistletoes have undoubtedly increased. Management practices, such as the incomplete removal of infested trees in timber sale areas, and the perpetuation of uneven-aged stand conditions (that promote the spread of dwarf mistletoe from overstory to understory trees), have also accentuated the distribution and impacts of the disease. At present, the magnitude of growth loss and mortality due to mistletoe on the Forest, though considerable, has not been documented.

An outbreak of pinyon *Ips*, triggered by the drought in the late 1990s and early 2000s, led to heavy mortality of pinyon trees in southwest Colorado (Eager et al. 2012). Pinyon mortality occurred at lower levels on the Forest relative to the forests west of the Continental Divide. Pinyon *Ips* generally affects only small clumps and individual trees (Eager et al. 2012).

White pine blister rust is a nonnative fungus that can infect the “five-needle” pines, such as limber and bristlecone pine. The rust does not spread from tree to tree, but is transmitted by windborne basidiospores between infected trees and an alternate host (often currents and gooseberries in the genus *Ribes*). The windborne spores can apparently travel long distances. The fungus can rapidly girdle young trees; mortality is slower on mature trees, but it can affect cone production by killing cone-bearing branches. Mature trees may also be more susceptible to bark beetle attack. This disease has been found in the Sangre de Cristo Mountains. This fungus could become important in future management strategies, such as the planting of rust-resistant limber and bristlecone pines.

The role of forest insects and disease is interwoven with other drivers and stressors of these ecosystems, including fire and climate change. Due to fire suppression policies, fire is generally affecting the landscape at lower than historic rates, which also affects the levels of insects and diseases. For instance, less frequent fire leads to denser, mature, even-aged ponderosa pine stands that are susceptible to mountain pine beetle. It can also lead to conditions favorable for outbreaks of dwarf mistletoes, root diseases, and western spruce budworm. In contrast, less frequent fire has led to lower amounts of aspen and hence, lower levels of western tent caterpillar.

Management activities associated with insects and disease are varied based on the management area designation of the location. In areas such as wilderness and roadless areas, insects and disease play their natural role. In the other portions of the Forest, management activities associated with insects or disease are generally designed to prevent or reduce epidemics by changing the mix of age classes, reducing tree density, promoting habitat diversity, or targeting specific trees for prevention or control. These management activities are generally minimal in nature and may include any of the following:

- thinning in ponderosa pine, mixed conifer, aspen with conifer (i.e., thinning the conifer component), or spruce-fir forests to reduce the risk of bark beetle and its associated mortality, reduce infection sources of foliage diseases, reduce habitat for defoliators, and improve vigor in residual trees,
- regeneration harvests in all forest cover types to reduce host habitat for insects and disease, and to establish vigorous young age classes of trees to ensure age-class diversity,
- sanitation cutting to remove and reduce infection sources for foliage, stem, and root diseases;
- application of pheromone treatments, both attractant and anti-attractant, to monitor populations or repel bark beetles from high-value trees,
- use of trap tree techniques to reduce spruce beetle populations in select areas,
- use of chemical sprays to repel or kill specific insects on high-value trees (such as in campgrounds),
- use of chemicals to inhibit or kill diseases (such as spreading borax powder on freshly cut stumps), or
- use of prescribed fire to reduce host habitat, thin stands, and sanitize diseased foliage (such as scorching of dwarf mistletoe-infected branches or trees).

Fire is also a disturbance process that is addressed in the *Fire Management* section.

Rare Communities and Special Habitats

This section addresses the rare communities and special habitats on the Forest. Rare communities and special habitats were are a key ecosystem characteristic needed for ecological integrity, as was identified and discussed in the assessment reports. Colorado Natural Heritage Program information was used to formulate this analysis.

Colorado has more than 500 recognized aquatic and terrestrial plant communities (Colorado Natural Heritage Program 2015). Many of these communities are considered rare either because they have always been rare or because they have become imperiled directly or indirectly by human-induced changes such as habitat loss, the introduction of exotic species, the alteration of natural disturbance regimes, or climate change. Aside from having intrinsic value, the loss of these rare communities may induce cascading ecosystem disturbances. In addition, a wider variety of species reduces our vulnerability to the impacts of climate change (USDA Forest Service 2011). Recognizing and protecting rare plant communities is crucial to preserving Colorado’s diverse natural heritage. The Colorado Natural Heritage Program methodology ranks species and communities according to their rarity or degree of imperilment and the importance of associated conservation areas. Prioritizing conservation efforts on rare communities and conservation areas that the Colorado Natural Heritage Program has identified are relevant to the Forest could help prevent the decline of the communities most at risk.

There are also areas that are generally thought of as rare or special from a plant and animal habitat perspective and warrant additional conservation considerations. These special habitat areas generally contribute disproportionately to species diversity relative to their actual size, or they may be habitat for species that occur nowhere else.

- Wetlands, which are sensitive to natural and human-caused stressors, support a high amount of species diversity, and provide a number of ecological functions such as flood control, water purification, and groundwater recharge.
- Fens, which are unique and irreplaceable wetland types.
- Riparian areas, especially low-elevation riparian areas, such as cottonwood/alder forests. This includes the narrow leaf cottonwood - Rocky Mountain juniper montane riparian community, which is imperiled in Colorado as well as globally imperiled (Sovell 2006).
- Oakbrush, which is rare in the San Luis Valley and on the Forest and supports a unique assemblage of wildlife species (about 2,600 acres on the Forest).
- Alpine fell fields and other special areas in alpine tundra.
- Caves and mines, which are unique geologic features that provide important habitat components for several of the 11 bat species known to occur on the Forest. The Forest has not identified any significant caves, but abandoned mine features are common in some areas.

Ponderosa pine forest where fire has played its natural role and aspen communities were included as rare communities in Assessment 1 and 3. Following public comment and internal discussion they are no longer considered as rare as the communities listed above.

The existing and proposed special interest areas and research natural areas and their related special habitats are described in Table 28.

Table 28. Existing and proposed special interest areas and research natural areas on the Forest

Name	Special character and features	Acres	Notes	CNHP PCA?
Mill Creek RNA (existing)	This area extends in elevation from 7,960 to 12,878 feet at the summit of Gibson Peak The extensive and high quality pinyon/juniper woodlands on the relatively gentle slopes of alluvial fans and steeper bedrock extending up to about 9,000 feet are the principal feature of this area In addition, mixed conifer and subalpine forests extend up to treeline on Gibson Peak. Subalpine grasslands blend into higher elevation alpine vegetation above treeline. Some riparian vegetation occurs along MilI Creek.	2,560		
North Zapata RNA (existing)	The area consists of a series of steep ridges separated by deep, narrow canyons containing the drainages of North and South Arrastre Creeks, North Zapata Creek, and Tellurium Gulch Vegetation extends from pinyon/juniper woodlands beginning at about 8,600 feet to alpine tundra at 12,300 feet The area is notable for its high-elevation limber pine stands mixed with bristlecone pine and an understory dominated by Thurber fescue. North-facing slopes support mixed montane forest, and above 11,000 feet, subalpine coniferous forest. South-facing slopes support open shrubland and woodland plant communities, aspen stands, subalpine grasslands, and riparian forests also occur within the area.	6,780		

Name	Special character and features	Acres	Notes	CNHP PCA?
Deadman Creek RNA (existing)	The area contains the complete watershed of Deadman Creek from an elevation of about 9,200 to 13,600 feet. Because most of the middle and upper parts of this watershed are covered with aspen, this RNA provides good representation for aspen forests over a wide range of elevations, slopes, and aspects. Some of this aspen forest is seral to Engelmann spruce and subalpine fir, and at lower elevations, to Douglas-fir forests; and some aspen is probably climax aspen forest. The area also provides good representation for many alpine ecosystem types within the Sangre de Cristo Mountains and for riparian vegetation types along the stream bottom Significant areas of mountain mahogany shrubland, oatgrass meadows, and wetland vegetation also occur within the area.	4,770	Overlaps a portion of the Deadman Creek Western Sangres PCA. This PCA supports a good example of the globally rare Smith whitlow-grass (*Draba smithii*). In addition, it supports the largest occurrence known of the rare narrowleaf cottonwood-Rocky Mountain juniper (*Populus angustifolia - Juniperus scopulorum*) montane riparian forest, and an excellent example of a rare aspen forest. Also, a newly described cottonwood community occurs within this site. A population of the Rio Grande cutthroat trout and a breeding colony of the pale lump-nosed bat (of which only four are documented in Colorado) add to the importance of this site. This site also includes one of the highest elevation occurrences of the mixed mountain shrubland and a globally rare orchid subspecies.	Yes
Spring Branch (Cedar Springs) RNA (existing)	Most of this proposed RNA is rolling topography covered by a mosaic of different grassland types and pinyon/juniper woodland. At higher elevations on the slopes of Horseshoe Mountain, montane forest is primarily Douglas-fir mixed with limber pine and small areas of aspen. Pinyon/juniper woodland is the dominant woody vegetation type in the area. The grasslands are similar to those of the short-grass prairie further east and occur in a complex mosaic of types that include the following species: blue grama, western wheatgrass, Arizona fescue, muhly, Indian ricegrass, needlegrass, Junegrass, and others. Small areas of shrubland, which include mountain mahogany, snowberry, and currant, occur on ridges and ridge slopes among the pinyon/juniper woodland.	4,000	Includes virtually all of the Cedar Springs Uplands PCA, which includes an excellent occurrence of a plant species vulnerable on a global scale, the rock-loving neoparrya (*Neoparrya lithophila*), a good occurrence of a plant community imperiled on a global scale, the pinyon pine/needle-and-threadgrass woodland (*Pinus edulis/Stipa comata*), and a fair occurrence of a plant community vulnerable on a global scale, the pinyon pine/Scribner needlegrass woodland (*Pinus edulis/Stipa scribneri*).	Yes

Name	Special character and features	Acres	Notes	CNHP PCA?
Blowout Pass SIA (existing)	This SIA was designated because of geologic and scenic values This is an area of hydrothermally altered volcanic rock displays, with vivid red, orange, and yellow soils in a rugged, highly eroded setting. Elevation ranges from 10,000 to 12,124 feet, slopes are generally steep (30 to 80 percent). Forested areas are Engelmann spruce, sub-alpine fir, and bristlecone pine. This SIA forms the headwaters of Jasper Creek and Burnt Creek, which are naturally polluted by sulfates and free sulfuric acid present in great abundance in the altered rock. Grasses and forbs are limited on open slopes because of soil composition and erosion.	1,260		
Ripley's Milkvetch SIA (existing)	This SIA was designated because of its botanical value. The SIA, in two separate areas, contains high-quality habitat for Ripley's milkvetch (*Astragalus ripleyi*).	5,280	The removal of the Ripley's Milkvetch Special Interest Area is not likely to impact the viability of this species of conservation concern due to the prolific presence of the plant outside the current boundaries of the special interest area. Unlike other sensitive plant species, Ripley's milkvetch responds positively to disturbance processes and activities like fire and grazing. Covers most of the Bighorn Creek PCA.	Yes
Liberty/Duncan SIA (existing)	The historic town sites of Duncan and Liberty and the associated mining development represent one of the most intact historical sites within Colorado and the Nation. Intermixed with these historic sites are the prehistoric sites which are advancing the understanding of prehistoric use and habitation in the area. This SIA emphasizes the management and protection of the historic and cultural values of this area over other uses.	3,910	Overlaps a portion of the Deadman Creek Western Sangres PCA. This PCA supports a good example of the globally rare Smith whitlow-grass (*Draba smithii*). In addition, it supports the largest occurrence known of the rare narrowleaf cottonwood-Rocky Mountain juniper (*Populus angustifolia - Juniperus scopulorum*) montane riparian forest, and an excellent example of a rare aspen forest. Also, a newly described cottonwood community occurs within this site. A population of the Rio Grande cutthroat trout and a breeding colony of the pale lump-nosed bat (of which only four are documented in Colorado) add to the importance of this site. This site also includes one of the highest elevation occurrences of the mixed mountain shrubland and a globally rare orchid subspecies.	Yes

Name	Special character and features	Acres	Notes	CNHP PCA?
Sheep Mountain Research Natural Area (proposed)	This area provides habitat for the Stonecrop gilia (*Aliciella sedifolia*), a species of conservation concern. Stonecrop gilia is an exceedingly rare plant found in only two locations in the world. The worldwide range of this plant is estimated to be only 1,900 acres. Only 1,100 individual plants occupy this range. This area also provides habitat for the Rothrock's townsend-daisy (*Townsendia rothrockii*), another species of conservation concern.	1,290	Includes a portion of the Sheep Mountains in San Juan potential conservation area. This PCA supports a fair occurrence of the globally critically imperiled stonecrop gilia (*Aliciella sedifolia*) and an extant occurrence of the globally imperiled Rothrock's townsend-daisy (*Townsendia rothrockii*). This site includes one of only two known occurrences of the stonecrop gilia in the world.	Yes
Cumbres & Toltec National Historic Landmark Special Interest Area (proposed)	This special interest area would reflect the recent designation of National Historical Landmark status for the railroad corridor by the National Park Service. Unique values include natural scenery, historic context to the formation of the forest and contributions to the economies of Antonito, Colorado and Chama, New Mexico.			
Spruce Hole/Osier/ Toltec Special Interest Area (proposed)	This special interest area would enhance habitat connectivity for large game species including mule deer, elk, pronghorn, and Rocky Mountain bighorn sheep as well as large carnivores such as Canada lynx, mountain lions, and black bears. It would also enhance ecosystem integrity related to the viability of several species of conservation concern and federally protected species, including boreal owl, peregrine falcon, Brewer's sparrow, flammulated owl, golden eagle, olive-sided flycatcher, bald eagle, Rio Grande cutthroat trout, Gunnison's prairie dog; Ripley's milkvetch, slender cliffbrake, Plumber's cliff fern, Colorado divide whitlow grass, and flowered gilia; federally protected species such as Mexican spotted owl, southwestern willow flycatcher, yellow-billed cuckoo, and New Mexico meadow jumping mouse; migratory birds including ferruginous hawks, black swifts, sage sparrows, burrowing owls, Cassin's finches, Grace's warblers, Gray vireos, juniper titmouse, Lewis's woodpeckers, loggerhead shrikes, long-billed curlews, mountain plovers, pinyon jays, and Virginia's warblers.	36,620	This area includes three different potential conservation areas recommended by the Colorado Natural Heritage Program. From map, this covers portions of Peak Site, Osier Creek, Cascade Creek at Osier, Rito Hondo Creek and Bighorn Creek potential conservation areas. The Peak Site PCA has an unranked occurrence of a globally vulnerable bird subspecies, the American peregrine falcon (*Falco peregrinus anatum*). Osier Creek and Cascade Creek at Osier PCAs both contain a good occurrence of a fish that is vulnerable on a global scale, the Rio Grande cutthroat trout (*Oncorhynchus clarki virginalis*). Rito Hondo PCA contains two good occurrences of a plant species vulnerable on a global scale, Ripley's milkvetch (*Astragalus ripleyi*). Bighorn Creek PCA contains a fair occurrence of Ripley's milkvetch (*Astragalus ripleyi*).	Yes

Name	Special character and features	Acres	Notes	CNHP PCA?
Chama Basin SIA (proposed)	This area is proposed for watershed protection.	17,780	This area is recommended as the Rio Chama Potential Conservation Area by the Colorado Natural Heritage Program for unique wildlife and botanical values. The PCA contains a good occurrence of mountain willow (*Salix monticola*) / mesic graminoids montane riparian willow carr. The site also encompasses a fair occurrence of narrowleaf cottonwood / thinleaf alder (*Populus angustifolia / Alnus incana*) montane riparian forest.	Yes
Summer Coon/La Ventana SIA (proposed)	This area would include the full extent of the unique geologic features related to the Summer Coon volcanic field. Adjacent to the Elephant Rocks Special Interest Area, it includes a nearly perfect pattern of radial dikes not currently included as part of Elephant Rocks. These areas include a medium-sized population of the rock-loving neoparrya, a rare milkvetch (*Astragalus cerussatus*) with only 20 known occurrences, nesting habitat for peregrine falcons and high quality habitat for bighorn sheep, a species of conservation concern.	14,840	The expanded area cover additional portions of the Eagle Mountain and Elephant Rocks Potential Conservation Areas recommended by the Colorado Natural Heritage Program for their high biodiversity significance. The Elephant Rocks site supports a fair example of a wetland plant imperiled on a global scale (*Peritoma multicaulis*), one good and two fair examples of plants vulnerable on a global scale (*Aletes lithophllus*) , and an excellent example of a San Luis Valley endemic pocket mouse subspecies. This site supports a medium-sized population of the rock-loving neoparrya, a south-central Colorado endemic plant. In addition to the rock-loving neoparrya, a rare milkvetch (*Astragalus cerussatus*) and a silky pocket mouse subspecies population occur here. A small occurrence of the grass fern (*Asplenium septentrionale*) at this site represents the southernmost extension of this uncommon fern. Eagle Mountain PCA includes nesting habitat for the federally listed American peregrine falcon.	Yes

Name	Special character and features	Acres	Notes	CNHP PCA?
Carnero Creek SIA (proposed)	This area is proposed for its unique concentration of native Rio Grande cutthroat trout populations.	42,800	Includes portions of the Carnero Creek potential conservation area. The Carnero Creek PCA supports a healthy population of a subspecies of native trout. This population of Rio Grande cutthroat (*Oncorhynchus clarki virginalis*) progresses in quality as one continues up the stream. At the lower elevations, the fish community is degraded by the presence of white sucker (*Catostomus commersoni*), a species introduced from the eastern slope of Colorado as bait fish. Also present at this site are community occurrences of globally rare montane grasslands (*Festuca arizonica-Muhlenbergia montana*), shrublands (*Alnus incana*/mesic graminoid), and woodlands (*Pinus aristata/Festuca thurberi*).	Yes
Jim Creek SIA (proposed)	This area is proposed for its unique concentration of native Rio Grande cutthroat trout populations.	9,560	Overlaps portions of the Jim Creek and Torsido Creek potential conservation areas. These PCAs support occurrences of the globally vulnerable fish subspecies, Rio Grande cutthroat trout (*Oncorhynchus clarkii virginalis*).	Yes
Deep Creek SIA (proposed)	This special interest area is proposed for its unique botanical values including habitat for two rare plants, Smith Whitlow grass (*Draba smithii)* and Black Canyon Gilia (*Alicelia/Gilia penstemonoides*). Both plants are species of conservation concern.	250	This area overlaps most of the Deep Creek Uplands West potential conservation area recommended by the Colorado Natural Heritage Program. This PCA supports a large population of the Colorado endemic and globally imperiled Smith whitlow-grass (*Draba smithii*) and a healthy stand of bristlecone pine (*Pinus aristata*) with Arizona fescue (*Festuca arizonica*). Smith whitlow-grass, an herbaceous mustard, has been found only in the southern Colorado counties of Mineral, Saguache, Costilla, and Las Animas, totaling about 15–20 occurrences. Of the known occurrences, Mineral County harbors the largest documented populations, and the Deep Creek site is among the best of these, with an estimated 500 individuals. Deep Creek also supports a small population of black canyon gilia (*Gilia penstemonoides*).	Yes

Diversity of Vegetation

Direct and Indirect Effects

Plan direction related to forested vegetation and silviculture varies among all alternatives. All four alternatives have the required timber-related plan direction as described in the National Forest Management Act and in Forest Service Handbook 1909. 12, chapter 60. In some cases, the plan direction wording was updated in the action alternatives (B, C, and D). Some additional plan direction present in alternative A was removed, updated, or combined in alternatives B, C, and D to remove unnecessary or outdated language and to clarify direction.

Desired conditions included in all action alternatives outlines the desired distribution of habitat structural stages for each of the major forested vegetation types. Stocking levels for suitable timber lands are also different between alternative A and the action alternatives. Minimum stocking levels in alternatives B, C, and D was reduced to 75 trees per acre in ponderosa pine and 100 trees per acre for Douglas-fir. Alternative A had the minimum stocking level for both these species at 150 per acre. This change would lead to lower density forests in these types, which would increase resiliency to stressors such as climate change, insects, and disease. These lower density values are also more aligned with the natural range of variation for these species, which were often found in more open conditions due to the more frequent fire regimes of these types.

As described above, the desired condition for vegetation in the action alternatives outlines the desired distribution of habitat structural stages for each of the major forested vegetation types. These desired conditions were generally based on natural range of variation estimates from the assessment modeling described in Assessment 1 and 3, with some adjustments to increase resilience to climate change. Some values from the San Juan National Forest Plan were used and adjusted, especially in cases where no modeling was available. Cool-dry mixed-conifer was adjusted to account for differences in species and the drier, less productive conditions that occur on the eastern side of the San Juan Mountains.

Comparing the current forest conditions to the desired conditions for the forested vegetation (Rio Grande National Forest Draft Revised Land Management Plan, Table 6) leads to the following conclusions:

- There is more acreage than desired in the mid-open (3A) structural stage in ponderosa pine.
- There is a lack of young (1T, 2T), mid-open (3A), and mid-closed (3B, C) stands in the warm-dry mixed-conifer areas, especially the young stands, relative to the desired amounts. There is an overabundance of warm-dry mixed-conifer forests in the mature (4A, B, and C) classes compared to the desired amounts.
- Slightly higher amounts occurred than desired in the mid- and mature-closed classes (3B, C, 4B, C) in the cool-moist mixed-conifer forests.
- In the cool-dry mixed-conifer forests, there is more acreage than desired in the mid-open (3A), mid-closed (3B, C), and mature-closed (4B, C) classes, and less than desired in the young (1T, 2T) and mature-open (4A) classes.
- Due to the recent spruce beetle outbreak, there is an abundance of spruce-fir in the young (1T/2T) class, with slightly more than desired in the mid-open (3A) and mature-open

(4A) classes. Less than desired amounts are present in the spruce-fir mid-closed (3B, C) and mature-closed (4B, C) categories.

- The majority of the pinyon-juniper woodlands are in the mid-open and mid-closed (3A, B, C) stages, with less than desired in the young (1T/2T) and mature (4A, B, C) classes.

Planned management activities by alternative are described in Table 29, Table 30, Table 31, and Table 32. The planned management acreage values are approximate and are an annual average per decade. These acreage values may vary from year to year due to budget, weather conditions, natural disturbances, or other factors.

Proposed management activities across alternatives include the following:

- Salvage sales in spruce-fir areas impacted by spruce-beetle. These sales are generally planned for the first decade of the plan, with the exception of alternative C. In alternative C, these salvage sales will be more intensive, and cover more acres in a shorter time period, to maximize the value of the salvaged wood. Associated with this is post-harvest pile-burning in these spruce-fir areas. Because these activities are generally done in areas with high mortality that are already in the young (1T/2T) structural stage, the activities won't necessarily change the structural stage. Post-harvest tree planting may speed forest recovery toward the desired conditions for this type of area salvaged that lacks regeneration.
- While not anticipated in green spruce-fir, a small amount may be treated through uneven-aged management over the life of the plan for reasons other than timber management.
- Thinning, uneven-aged management, and prescribed burning treatments in ponderosa pine and mixed-conifer forests. These treatments will help restore or maintain the more open conditions typically found in these forests and will help make them more resilient to climate change, insects, disease, and other stressors. More intensive shelterwood harvests in the ponderosa pine and mixed-conifer areas are also planned in alternative C. In the mixed-conifer type, these management activities will help reduce the amount of areas in the structural stages that are denser and with larger trees (3B, C and 4A, B, C) and increase the amount in more open and young stages.
- Aspen will be maintained on the landscape. Aspen regeneration harvests may occur, depending on whether there is a market for this material.
- Prescribed burning in grassland and pinyon-juniper woodlands. This is planned on a small acreage annually and does not vary by alternative.

In general, proposed management is highest in alternative C and lowest in alternative D, with alternatives A and B in the middle. Timber management levels in alternatives A and B are based on average base funding, with alternative C determined by base plus supplemental funding. Prescribed burning levels are similar across alternatives, with the exception of alternative A, which has less prescribed burning in the mixed-conifer areas. Estimates of pile burning in the spruce-fir areas vary according to the amount of salvage planned in each alternative.

Specific wildlife improvement projects, including but not limited to wildland fire, hydro-axing, and removal of encroaching juniper, may add an estimated 1,000 acres to Table 29 as opportunities arise.

Table 29. Planned management activity under alternative A – annual average per decade

Forest cover type/ Management Practice	1st Decade (acres)	2nd Decade (acres)
Spruce-Fir – Salvage Sales	3,210	0
Ponderosa Pine and Mixed-Conifer (thinning treatments, uneven-aged management) and Aspen (regeneration harvests)	100	1,200
Ponderosa Pine and Mixed-Conifer Prescribed burns	500	500
Spruce-Fir Prescribed burns	100	0
Grasslands Prescribed burns	100	100
Pinyon-Juniper Prescribed burns	50	50

Table 30. Planned management activity under alternative B – annual average per decade

Forest cover type/ Management Practice	1st Decade (acres)	2nd Decade (acres)
Spruce-Fir – Salvage Sales	3,210	0
Ponderosa Pine and Mixed-Conifer (thinning treatments, uneven-aged management) and Aspen (regeneration harvests)	100	1,200
Ponderosa Pine and Mixed-Conifer Prescribed Burns	700	800
Spruce-Fir Prescribed Burns	100	0
Grasslands Prescribed Burns	100	100
Pinyon-Juniper Prescribed Burns	50	50

Table 31. Planned management activity under alternative C – annual average per decade

Forest cover type/ Management Practice	1st Decade (years 1 – 6) (acres)	1st Decade (years 7 – 10) (acres)	2nd Decade (acres)
Spruce-Fir – Salvage Sales	6,280	0	0
Ponderosa Pine and Mixed-Conifer (thinning, uneven-aged management, and shelterwood treatments) and Aspen (regeneration harvests)	0	1,500	1,500
Ponderosa Pine and Mixed-Conifer Prescribed burns	700	800	800
Spruce-Fir Prescribed Burns (piles)	190	0	0
Grasslands Prescribed Burns	100	100	100
Pinyon-Juniper Prescribed Burns	50	50	50

Table 32. Planned management activity under alternative D – annual average per decade

Forest cover type/Management Practice	1st Decade (acres)	2nd Decade (acres)
Spruce-Fir – Salvage Sales	1,730	0
Ponderosa Pine and Mixed-Conifer (thinning treatments, uneven-aged management) and Aspen (regeneration harvests)	100	800
Ponderosa Pine and Mixed-Conifer Prescribed Burns	700	800
Spruce-Fir Prescribed Burns	50	0
Grasslands Prescribed Burns	100	100
Pinyon-Juniper Prescribed Burns	50	50

In general, in each of the four alternatives the Forest moves the identified desired distribution of vegetation structural stages, albeit at a slower rate in some alternatives relative to others. This varies by vegetation type, as little or no treatment is planned in some vegetation types, such as pinyon-juniper. Under alternative D, because there are fewer vegetation management activities planned, the progress toward the desired conditions in some vegetation types, such as mixed-conifer and ponderosa pine, would be slower. These types generally have higher amounts than desired in the larger size, more dense structural stages and less than the desired amount in the young stages. Management in these types would help meet the desired conditions. Progress toward the desired conditions in these vegetation types will be highest in alternative C, since this alternative has the highest level of planned vegetation management activities in these vegetation types. In the spruce-fir areas, where salvage is the focused management activity in the first decade, there would be varied progress towards the desired conditions given that the salvage harvests are done in areas that have high mortality and are already in the young structural stage. In some of the spruce-fir salvage areas, however, tree planting in currently understocked stands would speed forest recovery toward the desired conditions for this type. However, although planned management is different across the four alternatives, the distribution and diversity of vegetation structural stages across the Forest is predominantly determined by ecological succession and disturbances such as fire, insects, and disease, rather than by planned management activities.

Specifically assessing current conditions relative to those that correspond to natural range of variation is challenging. Although general descriptions of the forested types and their natural range of variation are available in published literature, these are broad and not Forest specific, and particular amounts or percentages by structural stage are not presented. The desired conditions were generally based on natural range of variation estimates from the assessment modeling, but with some adjustments to increase resilience to climate change, such as allocating slightly more acreage to the more open classes (3A, 4A) and slightly less to the more dense classes (3B,C, 4B,C).

Effects on Forested Vegetation from Timber Management

As described above, the timber management program may have a small effect on progress toward the desired conditions for vegetation across all alternatives. Under alternative D, because there are fewer vegetation management activities planned, the progress toward the desired conditions in some vegetation types would be close to natural succession rates. Progress toward the desired conditions in these vegetation types would be highest in alternative C because this alternative has the highest level of planned vegetation management activities. Although the planned management is different across the four alternatives, the distribution and diversity of vegetation structural stages across the Forest is predominantly determined by succession and natural disturbances such as fire, insects, and disease, rather than by planned management activities, especially given that about half the forested area is in protected areas, such as roadless areas and wilderness areas, where vegetation management activities are prohibited or greatly restricted.

Effect on Forested Vegetation from Recreation Management

One difference between alternative A and alternatives B, C, and D is the addition of management direction for congressionally designated trails including the Continental Divide National Scenic Trail and the Old Spanish National Historic Trail. Under alternatives B, C, and D, these trails are removed from the suitable timber acreage along with a one-half mile buffer on each side of the trail. This has a small effect on the suitable timber acreage because some, but not all, of this area would have been in the suitable timber acreage otherwise. The management direction for these areas is also more restrictive in terms of the type of vegetation management allowed.

Effect on Forested Vegetation from Wildlife Management

The main effects from the wildlife management program are related to lynx management direction. In addition, in more fire-adapted ecosystems, activities such as thinning, wildland fire, and hydro-ax are used as a vegetation management practice that also benefits wildlife.

The effect of new plan direction in alternatives B, C, and D is difficult to discern at this point. Overall, the Southern Rockies Lynx Amendment, as implemented currently, has changed the Forest vegetation management strategy and the silvicultural practices used. It also provided focus on uneven-aged management in live, green lynx habitat areas, which are mainly in spruce-fir and the cool-moist mixed-conifer vegetation types. The new direction on management activities would retain high-quality understory conditions that support important prey species for lynx.

The additional lynx-related plan direction in alternatives B and D would have minimal effect on the vegetation.

Effects on Forested Vegetation from Fire Management

Fire management on the Forest would have an impact on the vegetation. As prescribed in all alternatives in Table 29, Table 30, Table 31, and Table 32, planned prescribed burning estimates are similar across alternatives. The only exceptions to this are in mixed-conifer, in which more prescribed burning is planned under the action alternatives relative to alternative A. This additional prescribed burning would be beneficial in terms of helping reach the desired conditions for the mixed-conifer areas. Additional prescribed burning would also restore fire to its natural role in this ecosystem, reduce density, and improve resilience to climate change and other stressors. The action alternatives also have additional pile burning in spruce-fir areas corresponding to the amount of salvage harvest.

Overall, however, the potential impacts of wildfire over the life of the plan would be to create a more mosaic pattern across the landscape with increased diversity in species composition, age classes, and structure.

Effects on Forested Vegetation from Designation of Wilderness, Research Natural Areas, and Special Interest Areas

Recommended wilderness, research natural areas, and special interest areas may have a minor effect on progress toward the desired conditions for vegetation. Under alternative C, there are fewer of these proposed areas and under alternative D, there are more of these proposed areas, with alternatives A and B in between. Each of the four alternatives would move the Forest toward the identified desired distribution of vegetation structural stages, albeit at a slower or faster rate in some alternatives relative to others. A higher amount of these proposed areas simply means that more area would move toward the desired conditions naturally, without human intervention, than an alternative with fewer proposed areas, due to the reduced size of the suitable timber acreage and associated management levels. This effect is minor in that the distribution and diversity of vegetation structural stages across the Forest is predominantly determined by successional and natural disturbances such as fire, insects, and disease, and the fact that about half the forested area is already in protected areas, such as roadless areas and wilderness areas, where vegetation management activities are prohibited or greatly restricted.

Alternatives with a higher amount of area in these designations, such as alternative D, provide more acreage where fires, insects, and diseases can play their natural role. These areas are useful for comparison purposes and to determine ecological reference conditions.

Late-Successional and Old Forest

Direct and Indirect Effects

All alternatives have forest plan direction for late-successional and old forest management. All alternatives would provide some protection of existing old forest, and provide guidance on the identification and deferral from harvest of old forest areas. There is additional protection and guidance for late-successional habitats in alternatives B, C, and D, which are discussed below.

One important distinction among alternatives is the criteria used to define old forest. Alternative A defines old forest from Mehl (1992). This definition was general and not customized for the somewhat harsher and slower-growing conditions on the Forest. This definition was used as a starting point. The criteria were also changed so that most, but not all, of the characteristics need to be present for an area to be called old forest. Historically, although many old forest characteristics might be present, in most cases one of the characteristics was not present or was less than the amount needed for the area to be called old forest. The updated version of the old forest definition allows for more flexibility in determining old forest and allows areas with most, but not all, of the old forest criteria to be called old forest. The criteria used to define old forest is available in Appendix A for the draft forest plan.

All action alternatives contain forest plan direction related to late-successional and old forest habitat. Desired conditions recognize the importance of retaining the remaining live spruce-fir late-successional forest patches and of maintaining and enhancing late-successional and old forest conditions necessary for at-risk species. Desired conditions describe specific desired amounts of both late-successional (4B and 4C) and old forest habitats by vegetation type.

Forest plan direction for the General Forest and Intermingled Rangelands and Forest Products Management Areas has also been modified in Alternatives B, C, and D. These alternatives contain direction for Management Area 5.13 that "All succession stages are represented, including old forest. Mature stands are identified for old forest characteristics." This direction is different from that in alternative A, which has similar direction for both General Forest and Intermingled Rangelands and Forest Products and contains guidelines about the use of spatial analysis to select existing and future old forest stands that are retained and provide for habitat connectivity. The addition of a desired condition with specific desired amounts of late-successional and old forest in alternatives B, C, and D counterbalances the elimination of this direction in alternative A.

Alternative D has the largest amount of area in more protective categories, such as wilderness, roadless, research natural areas, and special interest areas. As a result, more old forest can develop without human intervention. In all alternatives, however, fire and other natural disturbances would continue to influence the landscape substantially more than vegetation treatments. Succession would continue to be the primary means by which late-successional and old forest is formed. Late-successional and old forest amounts and distribution would remain highly dynamic and variable over time.

Effects on Late-successional and Old Forest Habitat from Vegetation Management

A higher amount of area suitable for timber production and higher planned management levels (such as under alternative C), means fewer acres are developing naturally to late-successional and old forest. However, a larger suitable timber area also means there would be more control over manipulating vegetation and creating particular old forest characteristics. Vegetation treatments (such as thinning in young stands that encourages rapid tree growth) can promote the long-term development of some late-successional and old forest conditions, although this may be easier to accomplish in certain vegetation types, such as ponderosa pine and warm-dry mixed-conifer.

Snags and Downed Woody Material

Direct and Indirect Effects

Snag and downed wood conditions are largely dependent on the pattern of natural and human disturbance processes. Currently, due to the large spruce beetle outbreak on the Forest, there is an abundance of snags and downed woody material in the spruce-fir areas. However, in general, snags and downed woody material are very dynamic, highly variable, and unevenly distributed across time and space.

As previously stated, dead wood components will be created by fire, insects, disease, and mortality during the course of natural succession. Decomposition and fire are the primary ecological processes that recycle dead wood in the ecosystem. Vegetation treatments also remove dead wood. This is often the case in late-successional and old forest areas. Snags are predominant at first, shifting to predominantly downed wood as the dead trees fall. Snags will be lost as they fall to the ground to become part of the downed wood component, where they will decompose and become part of the soil. Ecological processes associated with snags and downed wood dynamics vary across forested ecosystems. Lower amounts of snags and downed wood would tend to occur in developed sites, areas where concern for fire hazard is elevated, and areas closer to communities and accessible to firewood cutting.

The majority of Forest lands are in unmanaged areas, where natural ecological processes and disturbances will be the primary factor affecting snag and downed wood conditions. These natural processes are expected to create an abundance of snags and downed wood at the Forestwide scale, and amounts within desired ranges.

All alternatives contain forest plan guidance that directs retention of snags and downed wood within planning units. All alternatives also have similar plan components related to management of insects and diseases.

A comparison of the retention direction for snags and downed wood retention among alternatives is provided below.

Direction included in alternative A states that prescriptions developed prior to timber harvest identify the distribution of coarse woody debris and snags to be left after harvest, as well as live green replacement trees for future snags.

The minimum requirements for adequate wildlife habitat and ecosystem function are listed in Table 33. The amounts are to be calculated as a per-acre average over a project area.

At least 50 percent of the snags retained should be in the larger size classes available onsite. Spatial distribution should be determined at the site-specific level.

Table 33. Snag and downed wood retention amounts in alternative A

Forest Type	Snags			Downed Wood[1]
	Minimum diameter at breast height	Minimum/Acre	Minimum height (feet)	Tons/Acre
Spruce-fir	12	2	25	10–15
Lodgepole pine	10	2	25	5–10
Aspen	12	2	25	3–5
Douglas-fir	12	2	25	5–10
Ponderosa pine	14	3	25	4–9

[1]All soft snags should be retained unless they are a safety hazard. If minimum-diameter snags are not present, use the largest available snags.

Snag and Downed Wood Retention – Alternatives B, C, and D

The minimum requirements for retention of snags and downed wood are listed in Table 34 (Draft Revised Land Management Plan, Table 5. These recommendations would meet the need to provide sustainable wildlife habitat and ecosystem function.

Table 34. Recommended snags and downed wood for wildlife habitat and ecosystem processes under alternatives B, C, and D

Forest Type	Snags			Downed Wood[1]
	Minimum diameter at breast height	Minimum/Acre in Planning Unit	Minimum height (feet)	Tons/Acre
Spruce-fir	[2]12	6	25	10–15
Cool moist mixed-conifer	[2]12	4	25	5–10
Aspen	10	5	25	3–5
Cool-dry mixed-conifer	12	4	25	5–10
Warm-dry mixed-conifer	[2]12	3	25	4–9
Ponderosa pine	[2]12	3	25	2–3
Lodgepole pine	10	3	15	5–10

[1] Project implementation should plan on leaving larger and longer logs onsite based on site capacity.

[2] At least 50 percent of the required snag numbers should represent the largest size classes available.

Alternative A

The Forest has been implementing this plan direction on retention of snags and downed wood for 20 years. As discussed previously in the *Affected Environment* section, the Forest is well-above the minimum amount of snags recommended for the various forest types, with the exception of the ponderosa pine forest type, where data suggest that there is less than the desired three snags per acre. The various forest types also have more than the minimum amount recommended of downed woody material, with the exception of ponderosa pine. Direction under alternative A should generally continue to meet the desired conditions for snags and downed wood, providing habitat and other ecological values.

Alternatives B, C, and D

Forest plan guidance for alternatives B, C, and D specify retention of snags and downed woody material. Additional snag and downed wood plan direction that are only a part of alternatives B, C, and D are listed in the Draft Revised Land Management Plan in the *vegetation*, *species of conservation concern*, *wildlife*, and *fire* sections.

Management direction related to snags and downed wood is the same under all action alternatives (B, C, and D). As compared to alternative A, the action alternatives provide for higher retention levels for snags and similar retention levels for downed wood, and make changes to spatial distribution of snags retained. Additional plan direction in the action alternatives also relates to the size and type of snags and downed wood to be retained. In some cases, such as aspen and ponderosa pine, the minimum diameter at breast height for the snags retained is higher under alternative A. In one case, ponderosa pine, the downed wood retention value is lower in the action alternatives, but this lower value is more aligned with the more frequent fire regime for this type. Although the snag and downed wood retention in alternatives B, C, and D applies to the planning unit, instead of the smaller project area (as in alternative A), the additional snag and downed wood plan components and generally higher snag retention amounts in the action alternatives as well as determinations made at the project-level, would help ensure that large openings created during salvage have sufficient amounts of snags and downed wood.

The presence, abundance, and distribution of long lasting, large-diameter snags depends entirely on the presence, abundance, and distribution of species and size classes of trees across the landscape in varied ecosystem types. Thus, the emphasis under all action alternatives on maintaining or achieving desired forest composition and size classes could be expected to achieve desired conditions for snags (and downed wood) over time as well.

There is a small difference among alternatives related to the difference in amount of area subjected primarily to natural disturbances processes compared to the areas where active vegetation management would occur (lands suitable for timber production) and areas with a recreation focus. These lands would tend to have lower amounts of snags and downed wood because of management direction, access, and the integration of other desired conditions for other resources. Because alternative D has more area that would be influenced mainly by fire and other natural processes, relative to the other alternatives, the amount and distribution of snags and downed wood would be greater under this alternative as compared to the others. This is supported by Forest Inventory and Analysis Program data that suggest higher snag levels in these unmanaged areas.

Effects on Snags and Downed Woody Material from Timber Management

Areas suitable for timber production where active management takes place make up a relatively small percentage of the total Forest area, just 17 to 26 percent. Areas suitable for timber production would typically be managed in ways that maintain relatively vigorous trees and limit losses from insects, disease, and fire where possible. This would result in lower tree mortality rates and a lower density of snags across these areas over time as compared to areas influenced less by human actions and affected more by natural disturbances, such as in wilderness and roadless areas. For instance, the majority of the spruce-fir forest type is in areas outside of the suitable timber base, regardless of the alternative. This is different than the areas with ponderosa pine and mixed-conifer vegetation types, which have nearly half their acreage in the suitable timber base for alternatives B and C. The persistence of snag habitat associated with these vegetation types would likely be more affected by human actions when compared to spruce-fir. On the other hand, active vegetation management provides opportunities to manage for species and forest size classes on these lands that would contribute to desirable future snag and downed wood conditions.

Salvage treatments planned in the spruce-fir vegetation type would result in lower snag and downed wood conditions in the treated areas. These treatments are proposed on the greatest number of acres in alternative C. In the long-term, tree planting in these areas may help speed recovery to mature forest conditions and provide for future snags and downed wood.

Thinning and other management planned in the ponderosa pine and mixed-conifer vegetation types may result in lower snag and downed wood conditions in the treated areas. These treatments are proposed to occur on the highest amount of acres in alternative C.

Firewood cutting also has an effect on the snag and downed wood levels present on the Forest. Firewood cutting predominantly affects lower elevation areas with roads and easy access.

Effects on Snags and Downed Woody Material from Recreation Management

Snag and downed wood levels are highly variable across the Forest. The recreation management program reinforces this variability. Removal of snags in campgrounds and along roadsides for safety reasons leads to fewer snags in these areas (and hence less future downed wood). This is also true for high-use recreation areas.

Landscape Disturbances and Patterns – Fire

Direct and Indirect Effects

Numerous drivers and stressors play a role in determining the patterns across the Forest landscape. Fire, insects and disease, and timber harvest are compared across alternatives below.

Alternative A

Management direction specific to fire management in alternative A requires all fires to be suppressed in some management areas, including those designated for forest products and ski-based resorts. Fire for resource benefit is approved for use and encouraged in areas where fire is allowed to play a natural role, such as in wilderness and in more remote, backcountry areas.

Alternatives B, C, and D

All the action alternatives contain the same forest plan guidance that articulates what role fire should play in the ecosystem. Management direction recognizes that risks to important values change in response to seasonal changes in weather and fuels, providing the opportunity to use fire as a management tool when conditions are conducive to meeting various plan outcomes.

Under all of the action alternatives the Forest is proposing to implement two strategic wildland fire management zones—the wildfire management zone: resource restoration and the wildfire management zone: resource protection and benefit. More information on fire management and wildfire management zones is contained in the *Fire Management* section.

The wildfire management zone for resource restoration allows natural resources to benefit from wildland fire. Managing wildfire to meet resource objectives in this zone is the least constrained. Ecological restoration is accomplished by managing wildland fire under a wide range of conditions that allow fire to play a natural role in an ecosystem. All lightning-caused wildfires in these areas will be managed primarily to restore and maintain the natural role of fire in the ecosystem with a minimal emphasis on suppression.

In the wildfire management zone for resource protection and benefit areas, conditions may put some natural resource values at varying degrees of risk for damage from wildfire. Wildfires that burn in this zone may benefit natural resources under certain conditions. All lightning-caused wildfires in these areas will be assessed on an individual basis for the most appropriate response based on values at risk and potential benefits to natural resources from a wildfire.

In both zones, all human-caused wildfires will be managed under a full suppression strategy commensurate with the values at risk.

Given the uncertainty of future climate and weather conditions, any of the action alternatives would provide fire managers with more flexibility in deciding how to manage individual fires and would allow fire to play a more natural role across the landscape. In that sense, the action alternatives would allow the role of fire to be most similar to its historic role.

Landscape Disturbances and Patterns – Insects and Disease

All alternatives generally have similar plan components related to management of insects and disease. Plan direction involves consideration of potential insect and disease outbreaks when planning management activities, managing vegetation to improve forest health and public safety, use of integrated pest management techniques, and designing project activities to minimize the risk of spreading existing infestations while still providing habitat for wildlife species, depending on insects and diseases. Plan direction generally applies to areas with ongoing management activities, which are portions of the landscape that don't vary much by alternative. Across all alternatives, more than half of the Forest is designated roadless or wilderness where insects and disease would play their natural role. Some direction included in alternative A was not carried into the action alternatives (B, C, and D). The direction not carried forward is related to controlling insects and disease in wilderness areas and controlling the spread of disease in adjacent stands during timber harvest.

Given integration of insect or disease management with silvicultural prescriptions for vegetation management to meet a variety of goals and objectives, impacts across the alternatives would correspond closely with acres thinned, harvested, or burned, especially those acres managed within the mixed-conifer and ponderosa pine type. These acres do vary by alternative, but are small in context with the total area in these vegetation types. The effects from insects or disease would tie more closely with forest conditions and affecting factors than from actual management activities. The forest condition and affecting factors include: 1) amount, extent, and susceptibility of host habitat, 2) insect or disease levels (extent and populations/infection rates), 3) climate, and 4) disturbance.

The impacts from chemical treatments or pheromone applications for insect/disease are expected to be similar across all alternatives. The majority of these activities would be focused in or near developed facilities.

Effects from Timber Management

Thinning treatments and sanitation harvests may provide an opportunity to prevent or reduce insect and disease outbreaks by reducing the density of trees, removing diseased and high risk trees, and increasing diversity. The removal of suppressed or dying trees would increase the overall growth and vigor of the remaining stand, which would decrease the susceptibility of those trees to many insects and diseases. As an example, management activities such as reducing basal area, favoring ponderosa pine where possible, and thinning from below can render stands less susceptible to damage from western spruce budworm (USDA Forest Service GSC 2016).

Alternatives that increase the amount, extent, or tree density of mature development stages would generally increase the risk of insect outbreaks or widespread disease. As a result of lower management rates, alternative D would have a greater likelihood of an increased amount and extent of mature, dense forest, and would therefore result in a slightly greater risk for insect outbreaks, or widespread disease, than other alternatives.

Because alternative C would be slightly less likely to increase the amount and extent of mature, closed development stages, it would result in a slightly lower risk for insect outbreaks or widespread disease. Alternatives A and B fall in between C and D.

Effects from Recreation

In developed and dispersed recreation sites where trees may be impacted by camping activities and where the overall health and vigor of trees is reduced by soil compaction, risk for individual trees to be adversely affected by insects and diseases would increase. Proposed management affecting recreation, relating to insects or disease, would be the same for all the alternatives.

Landscape Disturbances and Patterns – Timber Harvest

As described in the *Forest Products* section, the projected sale quantities and project salvage volume is highest under alternative C and lowest under alternative D. In alternatives A, B, and D, the focus of the vegetation management program would be on salvage harvesting beetle-killed spruce-fir stands that have high mortality due to spruce-beetle for the first decade, then transitioning to thinning/restoration treatments and uneven-aged management in the ponderosa pine and mixed-conifer vegetation types, along with possible aspen harvests. In alternative C, the vegetation management program would be similar, but with a focus on more intensive salvage harvesting in the beetle-killed spruce-fir areas for a shorter time period, 6 years, before transitioning to thinning/restoration treatments, uneven-aged management, and shelterwood harvests in the ponderosa pine and mixed-conifer types, along with possible aspen harvests.

Silviculture and vegetation-related plan direction differs between the no-action and action alternatives. Action alternatives reduce the minimum stocking levels for ponderosa pine and Douglas fir from alternative A. The lower density values are more aligned with the natural range of variation for these species and increase resilience to stressors such as climate change, insects, and diseases. Silvicultural systems by cover type were also expanded in alternatives B, C, and D. Other plan components that are applicable to the action alternatives are contained in the Rio Grande National Forest Draft Revised Land Management Plan. All alternatives include guidance that should produce conditions similar to those that occurred under natural disturbance regimes, with the exception that openings larger than 40 acres are generally not allowed unless one of the exceptions is met. Planned salvage sales are included in these exceptions, because they are the result of natural catastrophic conditions (refer to S-VEG-6 in the Rio Grande National Forest Draft Revised Land Management Plan).

Rare Communities and Special Habitats

Direct and Indirect Effects

All alternatives have areas where existing research natural areas, special interest areas, and wild, scenic, and recreational river areas overlap a portion of some potential conservation areas by the Colorado Natural Heritage Program. Research natural areas and special interest areas would have more restrictive direction related to the reason for their designation. They generally offer more protection for these potential conservation areas.

A special interest area for Ripley's milkvetch that covers most of the Bighorn Creek potential conservation area is unique to alternative A. Some of this area is included in the Spruce Hole/Osier/Toltec special interest area in alternative D. These are discussed in detail in the *Proposed Special Interest Areas and Research Natural Areas* section.

Alternative B has additional special designations that include a portion of potential conservation areas. Recommended wilderness in the Sangre de Cristo range covers portions of many different potential conservation areas. These include several potential conservation areas.

Alternative B also has recommended wilderness that overlaps portions of the Conejos River, Platoro, Lake Fork, Kite Lake, and Pole Creek potential conservation areas.

Alternative D is similar to alternative B, but with additional designations as follows:

- Recommended wilderness overlying portions of the San Francisco Lakes, Miners Creek, Pole Creek, Spar City, East Middle Creek, Kelly Creek, Ford Creek, and Luder Creek potential conservation areas.
- Sheep Mountain Research Natural Area, which includes a portion of the Sheep Mountains in the San Juan potential conservation area.

- Jim Creek Rio Grande Cutthroat Trout Area, which overlaps portions of the Jim Creek and Torcido Creek potential conservation areas.
- Carnero Creek Rio Grande Cutthroat Trout Area, which includes portions of the Carnero Creek potential conservation area.
- Elephant Rocks Botanic Area is adjusted to include the Natural Arch, with the addition of the adjacent Summer Coon/La Ventana Geologic Special Interest Area, covering additional portions of the Eagle Mountain and Elephant Rocks potential conservation areas.
- Spruce Hole/Osier/Toltec Landscape Connectivity area over Peak Site, Osier Creek, Cascade Creek at Osier, Rito Hondo Creek, and Bighorn Creek potential conservation areas.
- The proposed Deep Creek Research Natural Area overlaps most of the Deep Creek Uplands West potential conservation area.

Effects on Wetlands and Fens from Management of Other Resources

As discussed in the *Riparian, Wetlands, and Fens* section, the greatest future impacts to these ecosystems would come from those management activities that are known to have resulted in impacts during previous planning periods, including National Forest System roads and trails, uncontrolled motorized use on unauthorized roads and trails, and livestock grazing.

Alternatives A through D essentially represent varying partitions of acreage between a variety of potential uses, ranging from restrictive management prescriptions (e.g. wilderness) to general forest areas that are suitable for harvest, grazing, and dispersed/motorized recreation. Among all alternatives, the acreage of suitable rangeland remains nearly constant with the exception of small alterations based on special area designation. As a result, livestock grazing impacts to riparian and wetland ecosystems are expected to remain consistent with those observed in the previous planning period, and will not vary significantly by alternative.

Among the action alternatives, alternative D represents a minimization of acreages that would be available for expansion of the road/trail network, particularly for motorized vehicles and timber harvest. As a result, alternative D would likely have the fewest impacts on riparian and wetland ecosystems. Alternatively, alternative C represents a maximum number of acres available for the potential expansion of the motorized trail network, and the maximum number of acres suitable for timber harvest and the necessary access roads. Consequently, alternative C would likely have the greatest impacts to riparian and wetland ecosystems. The impacts of alternative A would likely be similar in magnitude to those of alternative C, even with a reduced suitable timber base, due to the lack of designated areas and recommended wilderness. The potential watershed impacts in order of magnitude would range from alternative D at the low end, to alternative B, followed by alternatives A and C at the high end.

Effects on Low-Elevation Riparian Areas from Management of Other Resources

Low-elevation riparian areas were identified in FSVeg Spatial as areas with a cover type of cottonwood or alder and are at an elevation below 9,000 feet. These areas totaled 977 acres on the Forest. Alternatives B and D are generally more protective of these areas, with 357 acres (37 percent) in recommended wilderness in the Sangre de Cristo range. Alternatives B, C, and D contain forest plan desired conditions specific to cottonwood riparian areas.

Livestock grazing can have, and has had, an influence on overall health of low-elevation riparian systems, including seeps and springs. As noted previously, the amount of suitable rangeland remains the same in all alternatives. No change to livestock grazing is anticipated; therefore, this impact to low-elevation riparian systems would continue. Concentration of native wildlife may contribute to stressors on these systems.

Effects on Oakbrush from Management of Other Resources

There are a limited amount of oakbrush acres on the Forest. Analysis using FSVeg Spatial with the proposed management areas by alternatives suggests that more acres of this type would gain protection under alternatives B and D, mainly due to recommended wilderness in the northern Sangre de Cristo range. Alternatives B, C, and D also contain specific plan direction for Gambel oak communities (see the Draft Revised Land Management Plan).

Effects on Alpine Fell Fields and from Management of Other Resources

Using FSVeg Spatial, approximately 53,024 acres of alpine habitat is currently afforded some protection because it occurs in existing wilderness. Alternative D proposes the most protection for alpine areas (as determined by acreage in recommended wilderness), with an estimated 24,236 acres. Alternatives A and C do not propose any recommended wilderness. Alternative B is in the middle with approximately 2,453 acres of alpine proposed for increased protection.

Alpine areas in the suitable timber base are minimal. Alternative A has the largest amount of alpine areas with approximately 239 acres, while alternatives B, C, and D have a lower amount of alpine areas in the suitable timber base, approximately 130 acres.

Recreational activities are a stressor in some alpine areas. No alternative proposed a change in the miles of trail or number of developed facilities. Dispersed camping in the alpine zone is thought to be limited due to the added elevation and potential difficulty of access. Much of the alpine zone is not accessible from roads or trails, is located in wilderness areas, or may not physically be accessible due to precipitous terrain. These areas would have lower impacts from recreation.

Areas with motorized trails that could impact the alpine areas include areas near Jasper and west of La Garita. Motorized trails also occur adjacent to and sometimes through alpine areas north of Creede on the northern Forest boundary, and areas near the western boundary.

Alternatives A, B, and C have similar acreages as suitable for over-snow vehicle use. Alpine areas within designated wilderness areas, as well as recommended wilderness areas, would not be suitable for over-snow vehicle use, but alpine areas outside of wilderness generally would be suitable for this use, with exceptions such as Finger Mesa and an area just east of the La Garita Wilderness. In these alternatives, alpine areas suitable for over-snow vehicle use include the area north of Creede and areas on the western portion of the Forest boundary.

Alternative D has less alpine areas suitable for over-snow vehicle use. Acres unsuitable for over-snow vehicle use under this alternative include the area north of Creede, areas on the western Forest boundary, and some areas near Jasper. This is mostly due to the higher amount of recommended wilderness in this alternative.

Forest visitors can participate in motorized or nonmotorized activities anywhere on Forest lands, which makes it difficult to assess recreation impacts. A more thorough analysis will be done as part of the travel management process.

All action alternatives include revised plan direction specific to and protective of alpine habitat. Alternative A includes plan direction that includes stipulations for leasable materials, which is not contained in the action alternatives (B, C, and D). Specific direction related to timber harvest within 600 feet slope distance from timberline also occurs only in alternative A.

There are grazing allotments in the alpine zone. They do not vary by alternative.

Effects on Caves and Mines from Management of Other Resources

Plan direction for caves and mines is included in all alternatives, though the action alternatives contain considerably more specific direction.

Cumulative Effects

The effects that past activities have had on forest vegetation were discussed previously in the *Affected Environment* section and are reflected in the current condition of the forest vegetation. Past management practices throughout the planning area, including fire suppression, have created forest conditions that are susceptible to insect outbreaks or disease due to higher tree densities and generally older and larger trees, leading to contiguous and homogeneous forest stands, especially in the lower elevation forest types.

Ongoing programmatic planning efforts occurring adjacent to the Forest that could have overlapping cumulative effects include:

- Revision of the Rio Grande County land use master plan
- Plan development for the Rio Grande del Norte National Monument
- Carson National Forest land management plan revision
- Grand Mesa, Uncompahgre, and Gunnison National Forests land management plan revision

Within the planning area, the cumulative impact of management activities could result in increased tree mortality rates across all forest cover types, large amounts of standing and downed dead trees, high fuel loading, and high intensity fire in areas of accumulated dead trees, in particular in the lower-elevation forest types. Beneficial aspects would be tied to species that have adapted to these types of disturbances, notably woodpeckers and other birds that feed on bark beetles and wood-boring insects. Also, many different species of plants that normally occur beneath conifer overstories are expected to vigorously increase in growth as competition and shade from overtopping trees dissipate with elevated rates of tree mortality.

Additional stressors that may increase in the future are increasing population levels, both locally and nationally, with resulting increasing demands and pressures on public lands. As related to forest and vegetation conditions, these changes may lead to increased demands for commercial and noncommercial forest products, elevated importance of public lands in providing for the habitat needs of wildlife species, and changing societal desires related to the mix of uses that public lands should provide. Gradually increasing recreation use over the planning period due to increasing population levels across Colorado could affect ecosystem integrity. However, the Forest's sustainable recreation plan direction included in all action alternatives provides measures to avoid such impacts from recreation activities.

The ability to implement future vegetation treatments is dependent on the use of prescribed fire as well as the use of natural, unplanned ignitions to meet resource objectives. Therefore, to the extent that air quality regulations may become more stringent in regards to the quantity and timing of smoke emissions, substantial effects could result from limiting vegetation treatments using prescribed burning.

Management activities on adjacent national forest, private, and state lands may affect rare communities and special habitats at the landscape level as well as vegetation conditions at the landscape level and changing forest composition and structures.

Overall, cumulative effects are not expected to increase from past, present, and reasonably foreseeable future planning activities within and adjacent to the Forest.

Fire Management

Overview

Wildland fire includes both wildfire (unplanned ignitions) and prescribed fire (planned ignitions). Fire management includes the strategies and actions used both before and during wildland fire. Management of wildland fire influences whether fire effects create beneficial or negative impacts to values such as water quality, air quality, habitat, recreation areas, and communities. Wildfire management includes a spectrum of responses from protection objectives to resource objectives (Figure 2). Suppression is a management strategy used to extinguish or confine unplanned ignitions.

Fuels management is the manipulation of vegetation for the purpose of changing the characteristics of a fire as it burns. Fuels reduction treatments result in a change in the amount, configuration, and spacing of live and dead vegetation, with the purpose of creating conditions that result in more manageable fire behavior and reduced severity.

Wildland Fire Management

Wildfires that reduce fuels and improve ecosystem conditions are characterized as "managing fires (or portions of them) to meet resource objectives." These fires tend to produce effects that are similar to, or trend toward, desired future conditions. Managing wildfires to meet resource objectives is a strategic choice to use an unplanned natural ignition to achieve resource management objectives and ecological purposes. The benefits of managing wildfires to meet resource objectives may include reducing fuels so that future fires burn with lower intensity and reduced smoke, resulting in wildfires that are more manageable and pose less threat to communities. Benefits may also include creating a diversity of wildlife habitats, cycling nutrients back into the soil, and reducing forest density to favor fire-resistant species such as ponderosa pine. Managing wildfires to meet resource objectives allows fire to resume a natural role in the ecosystem under pre-identified objectives and conditions, moving toward a more resilient ecosystem.

Effective wildfire management addresses the nature of wildfire and its contributing factors, recognizes the positive and negative consequences of fire, addresses uncertainty, and develops responses that reduce the chances of catastrophic losses, as cited in the National Cohesive Wildland Fire Management Strategy (Forests and Rangelands 2017). Forest and fire managers need to manage risk in both the short and long term. If the potential positive and negative consequences of fire are recognized, and management actions to obtain positive outcomes are matched, then the long-term risk to communities and assets is reduced, fire is restored as an ecosystem function to the landscape, and smoke impacts to communities are reduced.

Unplanned ignitions resulting in wildfires would continue to be a major disturbance process in most of the ecosystem types on the Forest. Uncertainty about future weather and changes in climate and the associated impacts to fire occurrence and severity remains a challenge to future land-management decisions and project-level analysis. Management activities that promote ecosystem diversity and resilience would allow these systems to better respond and adapt to the potential for increased fire occurrence and area affected by fire under potentially hotter, drier future climatic conditions.

The wildfire management continuum (Figure 2) shows the relationship between protection objectives and resource objectives. The continuum demonstrates how the location and conditions affect the management of wildfires or portions of wildfires. To interpret the continuum, consider the four dimensions of length, width, color, and teeth.

Figure 2. Wildfire management continuum

The side-to-side length of the continuum shows the spatial component, or the location where you are on the landscape. It affects the mix of objectives: on the left, the location favors protection objectives and on the right, the location favors resource objectives.

The up-and-down width of the continuum illustrates the different social, ecological, or environmental conditions affecting the mix of objectives that can be met from a wildfire. Protection objectives prevail along the top edge, while resources objectives are easier to meet along the bottom edge.

The colors depict the range of objectives, taking in the combination of both location and conditions. Red (upper left) represents the combination of conditions and landscape location that can cause higher risks to communities or ecological resources, resulting in protection as the predominant objective. Green (lower right) represents the combination of low-risk conditions and landscape location that make managing for resources the primary objective. The colors also represent the net value change to natural resources and community assets: red indicates a negative change (damage and risk) while green indicates a positive change (benefit). The fire-management response is to protect resources from potential damage and to obtain benefit. As risk is lowered on the landscape, more positive net value change opportunities exist over more locations and conditions, thereby increasing the ratio of green to red.

The teeth on each end indicate that the continuum wraps around in three dimensions to form a cylinder. A wildfire on the far right could be near an area with high risk, and that portion of the fire would be managed to meet protection objections. As fire management decisions reach the dotted line on the continuum, there are added considerations. Focusing only on protection can put people at risk, while focusing only on obtaining resources benefits can bring management risk to fire managers and decision makers.

All wildfires are managed on a continuum between meeting protection objectives and resource objectives, and the mix of these objectives is based on both the location of a wildfire (or a portion of it) and the conditions it is burning under. These objectives come from the forest plan, mainly in the form of desired conditions. The burning conditions change through the season and from year to year, providing both the opportunities and the restrictions.

Forest Service policy dictates that every wildfire has some aspect of a protection objective in a fire management response, as cited in Chapter 5 of the Interagency Standards for Fire and Fire Aviation Operations (National Interagency Fire Center 2017).

This response can vary from monitoring the fire under conditions that are conducive to obtaining resource benefits to an aggressive suppression effort to protect communities and natural resources from potential damages.

Unplanned, human-caused ignitions require a direct and aggressive suppression strategy.

Wildfires are not allowed to simply burn. Firefighter and public safety, risk to property, fire management resource availability, national and regional priorities, costs, and potential resource benefits are all factors in wildfire management decisions.

Fire on the landscape is a natural process, and many fires on the Forest are started by lightning. However, humans have also been a source of fire on the landscape for centuries. Intentional or not, fires have influenced vegetation succession dynamics. Fire is not a simple process, and many factors influence its character, including fuel loadings, climatic and weather conditions, topography, vegetation structure and composition, and elevation. Fires on the Forest generally move from west to east with the prevailing winds. Dry cold fronts produce northwest wind flows that move fires from northwest to southeast. Without wind as the driving mechanism, terrain and diurnal temperature changes are large influences on fire movement. Fire generally moves uphill faster than it moves downhill.

For each alternative, a wildfire continuum graphic is provided later, in the *Direct and Indirect Effects* section, with the percentages of each management area and how they would fit on the graphic. This graphic will facilitate qualitative comparison of the alternatives.

Fire Suppression

The successful suppression of wildland fire is dependent on many factors: fuels, weather and topography, suppression resource availability, and time of year. The alignment of these factors (e.g., hot, dry, windy, mid-June pre-monsoon) created the remarkable events of 2002 and 2013. When these factors (e.g., available personnel and equipment, cool moist, late season) are not aligned, fires are not typically not successfully suppressed. Even with the cooperative efforts of local firefighting resources from all levels of government, firefighting efforts during these remarkable years required substantial assistance from outside the area. During a busy fire season, suppression resources are spread thin, allowing fires to quickly exceed the capacity of the local firefighting unit and increasing the number of values at risk.

Fuels Management

Fuel reduction treatments are activities that change the amount, configuration, and spacing of live and dead vegetation, which alters fuels to reduce hazard. The costs, environmental impacts, and effectiveness of different fuel treatment types vary. Fuels treatments are conducted as efforts to make fires easier to control and reduce the resulting severe detrimental effects. Additional benefits include minimizing impacts to values at risk and reducing fire spread to other ownerships. Strategically located fuels treatments would also provide more opportunities to proactively manage the size and costs of future wildfires. In addition to modifying fire behavior, fuels treatments can achieve multiple resource benefits, such as producing timber products, creating desired wildlife habitat, and moving resources toward desired vegetation conditions.

Fuels reduction treatments include prescribed fire, mechanical treatments (feller-bunchers and masticators, etc.), and hand-thinning. Prescribed fires are fires intentionally ignited in accordance with applicable laws, policies, and regulations to meet specific, well-defined objectives. Mechanical treatments and hand-thinning are often done prior to prescribed burning, depending on project objectives and location.

As human development encroaches on the wildland-urban interface, the public enters a vegetation matrix that carries fire when conditions permit. The wildland-urban interface designation affects all fire management decisions in those areas. Although a wide variety of fire management strategies are available to implement, these options are generally narrowed because fire may move on to private lands. Hazardous fuels treatments in the wildland-urban interface focus on manipulating vegetation to enhance the success of subsequent fire suppression activities. Since 2001, fuels management has focused on modifying fuel conditions to meet various objectives to reduce threats to values at risk, increase suppression success by minimizing crown fire likelihood, decrease fire intensity, and decrease the rate of spread.

Affected Environment

The spatial boundary for the analysis of fire and fuels management effects is the lands administered by the Forest as well as lands of other ownership, both within and adjacent to the Forest boundary.

Existing Conditions and Trends

Recent Wildfire History and Trends on the Forest

The Forest has gathered a comprehensive dataset for fires that have occurred on the Forest from 1970 through 2016. From the Forest Service FireStat program, these data list the date, location, cause, and size of each fire within that time period. Records of fires prior to 1970 were fragmentary and an accurate fire history could not be obtained for that period. The 46-year period from 1970 to 2016 showed 781 fire occurrences, or an average of 17 fire starts per year (Figure 3). The predominant cause of wildland fire on the Forest is lightning (68 percent), and the remainder (32 percent) have a human-caused origin (Figure 4).

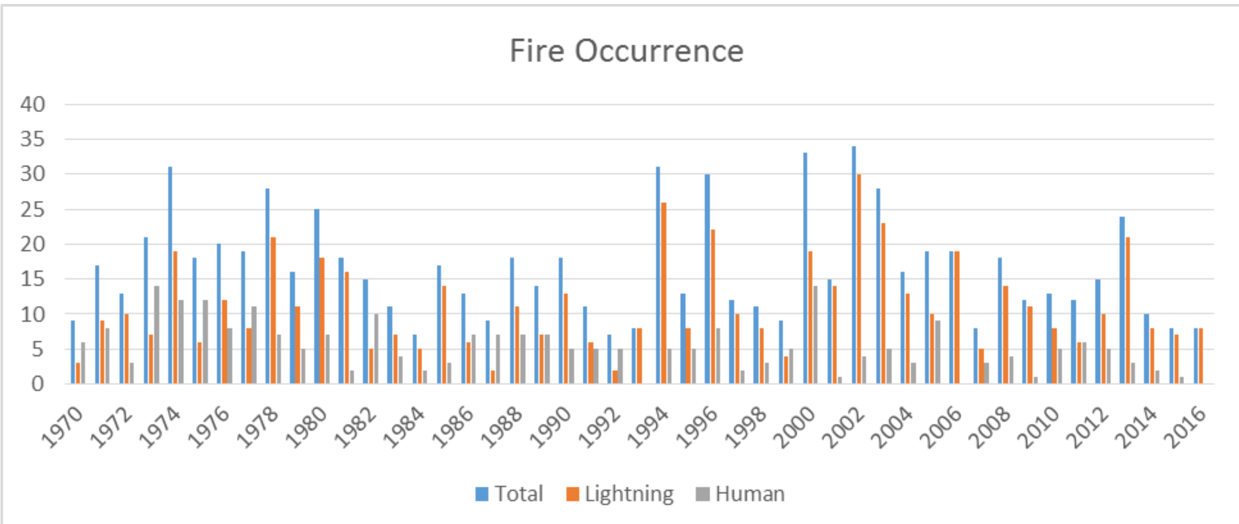


Figure 3. Fire occurrence, 1970–2016 (FireStat)

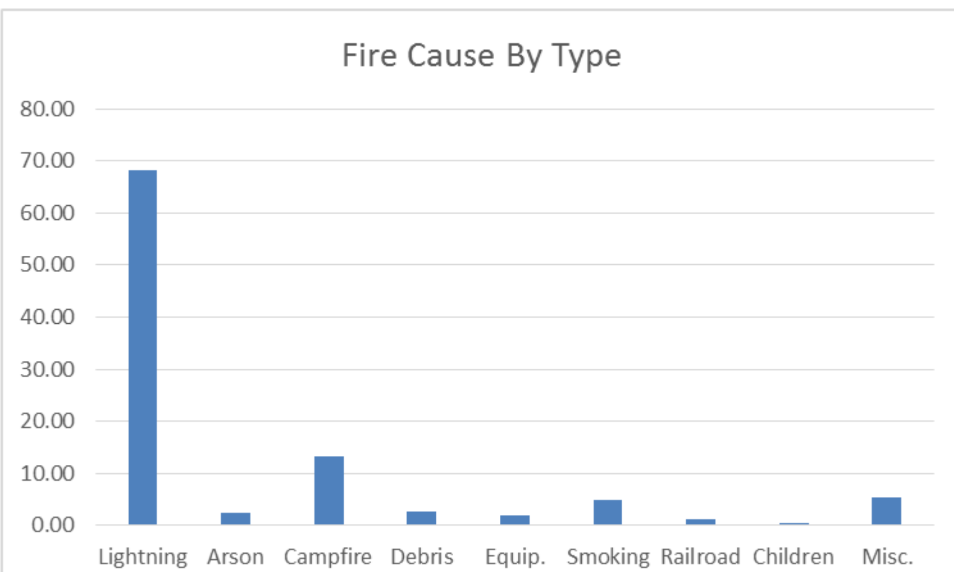


Figure 4. Fire cause, 1970–2016 (FireStat)

With the exception of two extremely large fire years (2002 and 2013), the average fire size was about 42 acres, but the majority of the fires (72 percent) were less than 0.25 acre in size (Figure 5). A long-term drought from the late 1990s though 2013 set the stage for two exceptionally large fire years. In 2002 an estimated 9,528 acres burned and then in 2013 approximately 89,938 acres burned. This decade's long dry period saw several other large fires in areas adjacent to the Forest, including the 2000 Sand fire, which burned about 5,000 acres and the 2010 Medano fire, which burned about 6,200 acres in Great Sand Dunes National Park. Also in 2007, the Mato Vega fire burned about 7,000 acres on the Trinchera Ranch near La Veta Pass. This increase in the number of large wildfires (more than 1,000 acres) since the late 1990s is consistent with trends across other Western forests (Westerling et al. 2014).

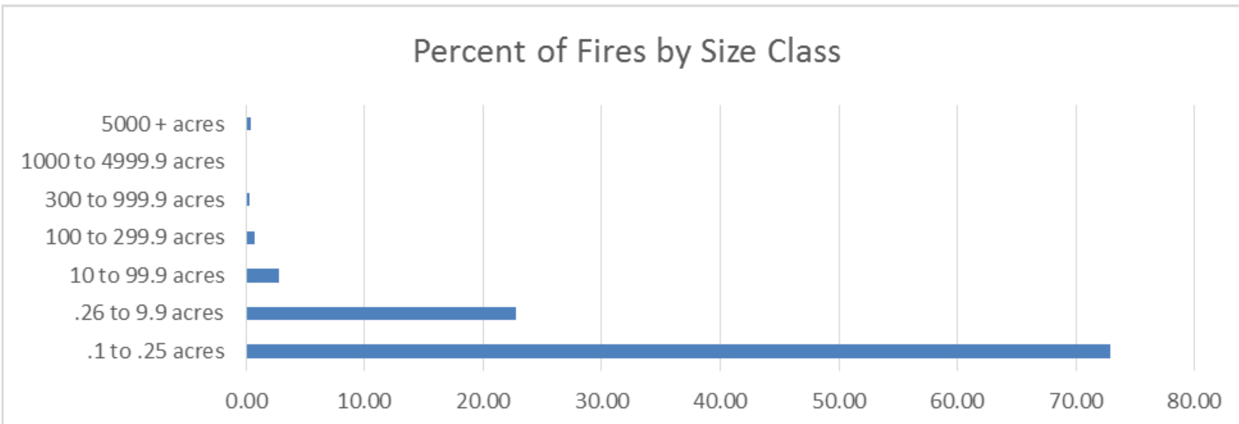


Figure 5. Percent of fires by size class

Natural Range of Variation

Wildfire is a natural part of forest ecosystems. The historical fire regime varies widely across the different ecosystems. Historic fire regime information for the Forest was developed as part of Assessments 1 and 3 (USDA Forest Service 2016). The major ecosystems that are affected by wildfires are listed below.

Spruce-Fir Forest Ecosystem

Prior to unplanned, human-caused ignitions, the two most significant broadscale disturbance types in these communities were stand-replacing fires and bark beetle outbreaks (Baker and Veblen 1990, Veblen et al. 1994, Veblen 2000). In between these broadscale forest disturbances, finer-scale processes such as insect infestations, avalanches, blow-down events and fungi shaped the structure and composition of spruce and fir stands (Veblen et al. 1989, Veblen et al. 1991a, Lertzman and Krebs 1991, Roovers and Rebertus 1993).

With late snow packs and frequent summer precipitation in these high-elevation forests, there are typically long intervals between fires, and fires that initiate when fuels are not sufficiently dry are generally small. Wildfires in the spruce-fir forests are typically driven by regional weather patterns, and larger fires are generally experienced only after extended dry periods.

Wildfires that occur in these forest types during drought periods are typically more severe than fires at lower elevations because of the fuel buildup. In the nearby San Juan Mountains, fire return intervals in the spruce-fir forests were historically almost 300 years, with many stands escaping fire for many hundreds of years (Romme et al. 2009) and with intervals varying with moisture regimes and topography. Post fire, the dominant conifers generally reestablish by seeding and aspen by root-sprouting (Stahelin 1943, DeByle and Winokur 1985, Johnson and Fryer 1989, Veblen et al. 1991a, Turner et al. 1997). Wildfires, particularly at lower elevations, were typically followed by the rapid re-establishment of aspen with spruce-fir growing up in the understory, which would gradually displace aspen after several hundred years. As fire disturbance is compounded with insect outbreak and changes in climate, it is predicted that aspen will become more prevalent in subalpine systems (Kulakowski et al. 2013).

Despite fire exclusion policies, spruce-fir forests have remained relatively unchanged because fire return intervals are naturally long relative to the amount of that fires have been suppressed. Fire suppression activities in lower-elevation systems, however, have reduced the frequency of fires burning into higher-elevation systems (Barrett 1994, Baisan and Swetnam 1997).

Cool-Moist Mixed-Conifer Ecosystem

The cool-moist mixed-conifer forests are characterized by high-severity fires occurring at long intervals (more than 100 years) with occasional small, low-severity fires (Fule et al. 2009, Romme et al. 2009). Cool-moist mixed-conifer stands have less frequent fire return intervals compared to warm-dry mixed-conifer stands. When fires do burn through these stands after a long period of no fire, the fuel that has built up creates a higher intensity fire than what is observed in the warm-dry mixed-conifer forests. In some cases after a high severity fire, aspen can remain the dominant species, depending on the extent and severity of the fire and the amount of conifer seed sources present.

The combined factors of fire exclusion, selective logging, and changes in climate have altered warm-dry mixed-conifer stands more, but even in cool-moist mixed-conifer stands, there are some areas with dense growth of smaller trees and little to no Douglas fir regeneration and a reduced aspen component.

Warm-Dry Mixed-Conifer Ecosystem

The warm-dry mixed-conifer ecosystems have more frequent, less severe fires (20 to 50 years) with rarer, more severe fires. As a result, stands were characterized by relatively open stand structures. However, there was heterogeneity with patches of denser stands. Median fire intervals in the nearby San Juan National Forest for these systems was 18 to 28 years (Romme et al. 2009), but fire regimes vary even within the mixed conifer subclasses along moisture continuums (Korb et al. 2013). Where these stands experience high severity fires, there is the possibility for them to be converted to mountain shrublands.

Like cool-moist mixed-conifer stands, fungal infections and insect outbreaks, including spruce budworm, play a role in stand dynamics. Heavy livestock grazing and fire suppression likely have especially influenced the fire regimes of the warm-dry mixed-conifer forests. Grazing compounded the influence of fire suppression by further increasing the time between fires. The selective harvest of ponderosa pine also likely altered mixed-conifer forests, particularly the dry mixed-conifer stands. The combined factors of fire exclusion, selective logging, and changes in climate have created warm-dry mixed-conifer stands that are comprised of more, smaller trees than were present historically.

Pinyon-Juniper Woodland Ecosystem

Pinyon and juniper systems can be classified as persistent woodlands, savannas, or wooded shrublands depending on canopy structure, understory composition, and historical disturbance regimes (Romme et al. 2008). Fire rotations historically varied, but were generally quite long (e.g., many centuries). The longest fire return intervals likely occurred in the persistent woodlands with shorter interval in the other classes, but there is less confidence in the understanding of fire behavior in these types. The Forest includes combinations of the three types, but this has not been defined or mapped.

Stand dynamics may be more driven by climatic fluctuations, insects, and disease than fire (Eisenhart 2004, Romme et al. 2008). Although pinyon-juniper density has likely increased to some extent in the recent past, the current extent compared to past distribution has not been well analyzed. Fire exclusion in pinyon and juniper systems cannot be the primary mechanism for expansion and infill of these woodlands because fire was never very frequent in these systems and therefore they are not likely departed from historic fire return intervals in most places (Romme et al. 2008), though there is less certainty in pinyon-juniper savannas.

Southern Rocky Mountain Montane-Subalpine Grassland Ecosystem

Natural drivers of these grasslands were grazing by native ungulates and fire. Native ungulates in these systems likely moved through as needed, and the extent and severity of their grazing varied. Fire regimes associated with these grasslands are correlated to the fire regimes of the forest surrounding them. Lower-elevation Arizona fescue grasslands were likely characterized by frequent, low-severity fire regimes, while the higher-elevation Thurber fescue grasslands experienced less frequent and more severe fires (Romme et al. 2009). These fires recycled nutrients, reduced litter, stimulated new plant growth, and eliminated woody plant growth.

Sagebrush Shrubland Ecosystem

Along with fire suppression efforts, grazing may have increased fire intervals in sagebrush systems through the reduction of fine fuels. However, introduction of cheatgrass (*Bromus tectorum*), an invasive annual grass, can serve to increase fire frequency through a positive feedback cycle (Whisenant 1990). Fire in sagebrush systems reduces decadent sagebrush stands, promotes understory growth and nutrient cycling, and creates a mosaic of sagebrush structures and community types across a broad landscape. Regardless of fire severity, fire in sagebrush is stand-replacing (Sapsis and Kauffman 1991) and sagebrush can be slow to reestablish. Historic fire regimes are difficult to ascertain directly and likely varied with sagebrush species, elevation, and other abiotic factors. Estimates of fire rotations for sagebrush systems generalized across the West from a few studies (Baker 2006) are 325 to 450 years for low sagebrush, 100 to 240 years for Wyoming big sagebrush, and 70 to 200 years for mountain big sagebrush. If these estimates are correct for the sagebrush shrublands, they are not likely very departed from their historic fire intervals. A reduction in fire occurrence in this type may allow conifer encroachment into shrublands.

Expected Future Fire Trends

Fire has been a fundamental part of the southern Rocky Mountains for thousands of years, whether naturally ignited or human induced (i.e., by Native Americans). Fire, fuels, and climate are closely interrelated. Natural, long-term variations in temperature and precipitation patterns have resulted in continuously changing fire regimes (Whitlock et al. 2008), and thus continually changing forest conditions. This past climatic variability has had major effects on the timing, frequency, intensity, severity, and extent of wildland fires, as would potential future changes in climate. The effect may be due to direct climate-related factors, such as increased temperature and greater drying of forest fuels, or may be indirectly related to potential changes in forest composition and structure due partly to climate change (refer to the Assessments 1 and 3 (Terrestrial Ecosystems assessment report): *Key Ecosystem Characteristics* section, *Vegetation Dominance Types* and *Forest Size Classes* subsections (USDA Forest Service 2016)). These climate-induced changes in fire regimes could have substantial impacts on ecosystems, with associated effects to communities and economies (McKenzie et al. 2009). It is readily apparent that vegetation, fire, climate, and weather are closely interconnected, and the relationship between the multiple aspects of each is extremely dynamic and complex.

A recent comprehensive synthesis of the science surrounding climate change and ecosystems (Vose et al. 2012) concluded that all fire regimes in western forest ecosystems would experience some increase in fire risk. More fires occur because of longer fire seasons and higher human populations (Peterson et al. 2012). Fire intensity and severity will probably be higher as well because of more extreme fire weather (i.e., hotter temperatures) and higher fuel loadings (i.e., tree mortality, increased forest densities). In moderate (mixed) severity regimes, more frequent fires could convert lands to more of a low severity fire regime, where frequent fires favor more open stand conditions and tree species resistant to fire damage. Increased fire risk and fire sizes in high severity fire regimes could have significant local effects, especially where close to human population centers. These risks are increased because of increased occupation of the wildland environment.

Large fire simulations modeling from 2016 showed an increase in burn probability at higher elevations. Increases were mainly due to changes in projected hotter and drier weather conditions associated with anticipated climate changes, and reflected the changes in fuels conditions following the spruce beetle outbreak. The 80th, 90th, and 97th percentiles of energy release are compared with the number of fire growth days in Table 35.

Table 35. Increase in fire growth by energy release component

Energy Release Component (percentile)	Pre-1992 (days)	1992-2001 (days)	1992-2015 (days)	Percent Increase Pre-1992 to 2015
80th	73	80	106	69
90th	37	40	51	73
97th	11	15	18	61

Recognize Constraints to Fire Management

Generally, a very large number of burnable acres cannot be actively managed by mechanical means, and an even larger number cannot be economically treated with prescribed fire because they are designated as wilderness, or are in designated roadless areas where activities are restricted or more difficult to implement. Appropriately managing wildfire in places with an opportunity to obtain resource benefits and a low risk of potential damages may be the only way to increase the pace and scale of ecosystem restoration activities. Informed management of wildfire would also need to be a method to maintain areas once restoration has occurred.

Comparison of All Alternatives

Using the wildfire continuum as a metric for comparison of the overall intent of each alternative, the alternatives generally fall along the spectrum from protection to resource objectives. The results shown are based on land allocations by management for each alternative and how the management areas are grouped into wildland fire management zones. *Fire Management Zone maps for alternatives B, C, and D* are contained in the DVD located at the back of this document.

Direct and Indirect Effects

Alternative A, No Action

Management direction specific to fire management from the current forest plan requires suppression of all fires in the Forest Product and Ski-based Resort Management Areas. Fire is managed for resource benefits in most other management areas, and is a natural part of the landscape in wilderness and backcountry areas.

Alternative A desired conditions recognize the role of fire in the ecosystem when and where life, property, and timber resources are not threatened. Areas including wilderness (Management Areas 1.11, 1.12, and 1.13), Backcountry (3.3), eligible Wild Rivers (1.5), and Research Natural Areas (2.2), allowed for prescribed natural fire use to meet objectives. Also the amount, arrangement, and continuity of fuels, both live and dead, is consistent with land uses and estimates for historic fire regimes.

The fire management continuum for alternative A is shown in Figure 6. Based on the analysis, fire suppression would continue to be practiced on 30 percent of the Forest. These acres are associated with areas that present more values at risk that are in need of protection. Fire suppression is costly and results in unnatural fuels build up that under the proper conditions influences subsequent suppression efforts.

On about 47 percent of the more remote areas of the Forest, such as backcountry and wilderness, naturally caused fire is monitored and allowed to burn to meet predetermined resource objectives.

On the remaining 23 percent of the Forest acres, naturally caused fires can be monitored and allowed to burn to meet resource objectives unless there is an immediate threat to life, property, or valuable resources.

Prescribed fire would continue to be used as needed to accomplish resource objectives or reduce wildfire threats to communities, resources, and infrastructure.

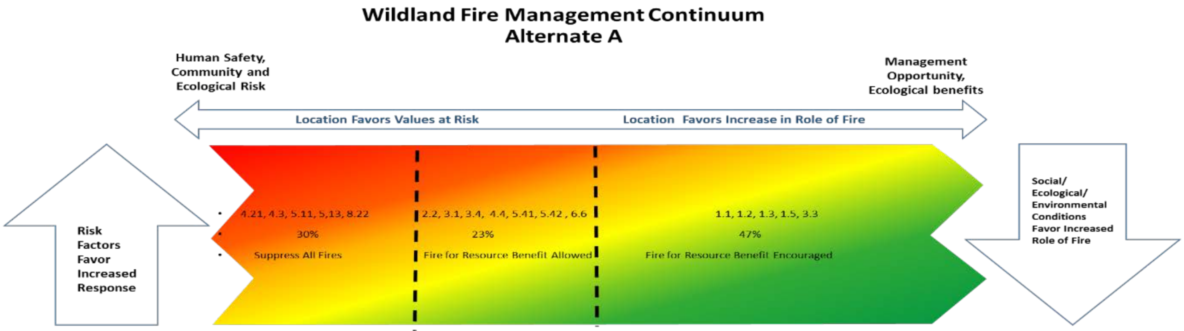


Figure 6. Wildfire management continuum, alternative A

Effects Common to All Action Alternatives

All the action alternatives contain the same desired conditions and guidelines that articulate the role of fire on the Forest. Management direction recognizes that risks to important values change with seasonal changes in weather and fuels. This provides an opportunity to use fire as a management tool when conditions are in compliance with various plan objectives.

Alternatives B, C, and D propose to implement strategic wildland fire management zones. The acres within each wildland fire management zone influence how fire management can be implemented for each alternative. The zones are applicable at the geographic area level in alternatives B and D, though more specific direction may be needed at the management area level. Alternative C applies the wildfire management zones at the management area level. Assigning these strategic wildland fire management zones supports decision makers before ignition occurs. Pre-assessing areas for risks and benefits from prescribed and wildfire before a fire occurs establishes more consistent direction in a shorter amount of time. Key to the wildfire management zone concept is the understanding that all fires can be managed to meet multiple resource objectives. Two strategic fire management zones are proposed:

- Wildfire management zone: resource restoration
- Wildfire management zone: resource protection and benefit.

The **Wildland Fire Management Zone: Resource Restoration** applies generally to the Primitive Wilderness and Roadless Geographic Areas in alternatives B and D, and to the corresponding management areas in alternative C. These areas present a lower risk to resource values from a wildfire, and conditions allow natural resources to benefit from wildland fire. Management of wildfire to meet resource objectives in this zone is the least constrained.

Ecological restoration would be accomplished by managing wildland fire under a wide range of weather, fuel moisture, and other environmental conditions that allow fire to play a natural role in the ecosystem. The use of prescribed fire to meet specific resource objectives is also appropriate.

All lightning-caused wildfires would be managed primarily to restore and maintain the natural role of fire in the ecosystem. However, suppression action would be taken to mitigate wildfire threats to communities and other non-natural resource values, while allowing the wildfire to play a natural role in the ecosystem.

Human-caused wildfires would be managed by using a full suppression strategy commensurate with the values at risk.

The **Wildland Fire Management Zone: Resource Protection and Benefit** applies mostly to the General Forest Geographic Area and Specially Designated Geographic Areas. These are generally areas where current conditions may put some natural resource values at varying degrees of risk from wildfire. Some areas in this zone may have conditions that place communities and other non-natural resource values at risk from wildfire. A variety of tools, including mechanical treatments and prescribed burning, can be used to promote ecological restoration before using wildfire under a wider range of weather, fuel moisture, and other environmental conditions. Wildfires that burn in this zone may benefit natural resources under certain conditions.

All lightning-caused wildfires in these areas would be assessed on an individual basis for the most appropriate response based on values at risk and potential benefits to natural resources from a wildfire.

All human-caused wildfires would be managed using a full suppression strategy that is commensurate with the values at risk.

Alternative B

Because so much of the Forest area is either wilderness or roadless, alternative B allocates an even balance between the two fire management zones (Figure 7).

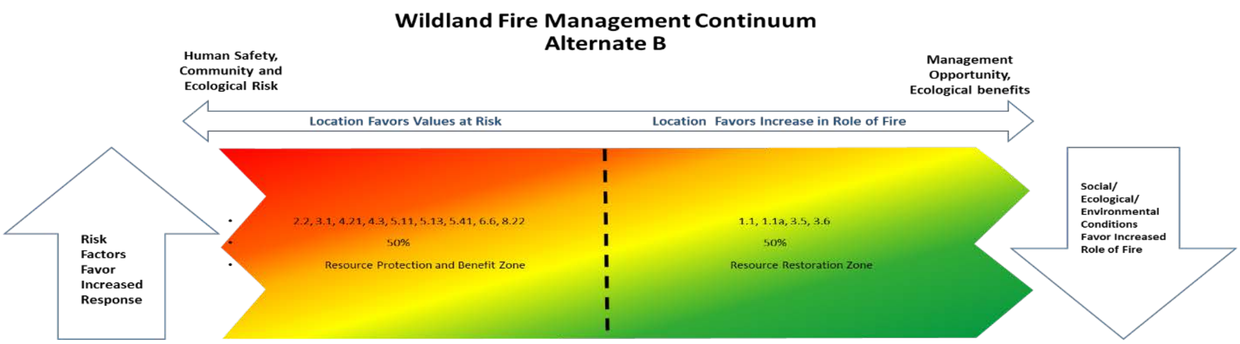


Figure 7. Wildfire management continuum, alternative B

Alternative C

The emphasis of alternative C is on multiple use. This alternative has the fewest acres in designated wilderness, recommended wilderness, and special designated areas. This alternative would shift more acres into resource protection and benefit the wildland fire management zone, which could provide more flexibility for fire suppression and increased opportunities of mechanical and prescribed burn fuel treatments (Figure 8).

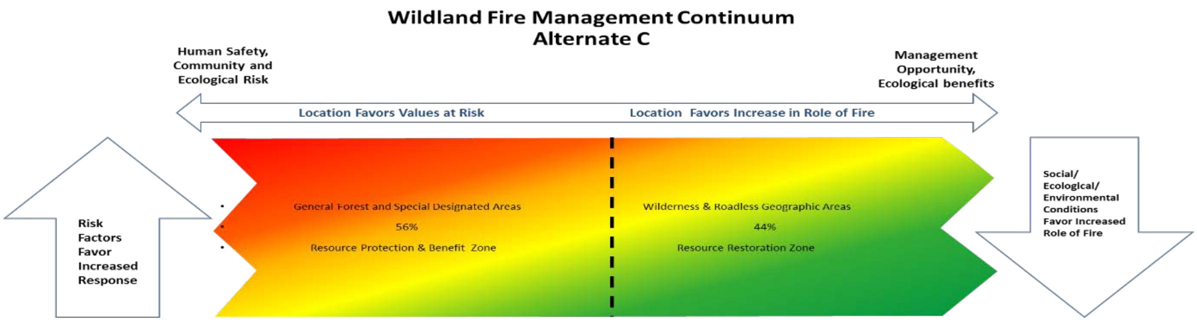


Figure 8. Wildfire management continuum, alternative C

Alternative D

The emphasis of alternative D is on resource protection (Figure 9). This alternative has the most acres of wilderness and recommended wilderness, roadless and backcountry areas, and special designated areas. The expectation is that unplanned wildfire would be used more frequently to meet resource objectives, with an emphasis on nonmechanical treatments on these acres. Management Areas 2.2 – Research Natural Areas and 4.23 – Congressionally Designated Trails that overlap and bisect wilderness and roadless area designations, and 3.3 – Backcountry, are included in the resource restoration wildland fire management zone.

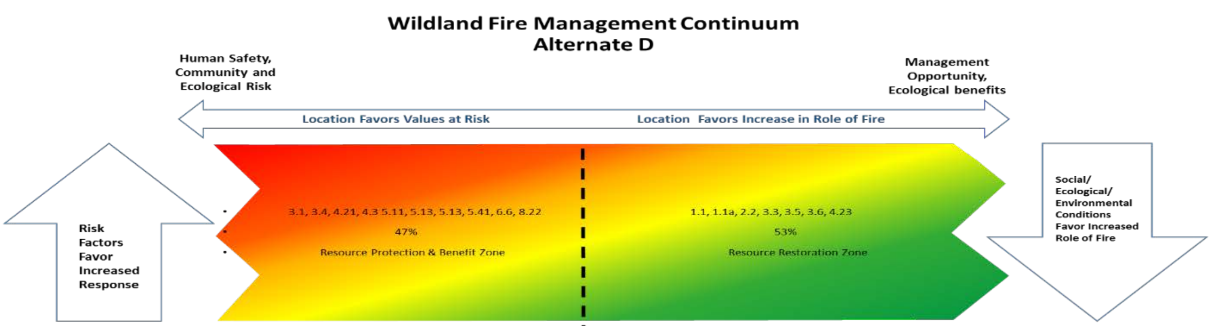


Figure 9. Wildfire management continuum, alternative D

In summary, a major difference between the no-action and action alternatives is the requirement to suppress all unplanned wildland fires in some of the management areas under alternative A. There are minor differences in the amount of acres that would be assigned to each of the fire management zones between the action alternatives. Given the uncertainty of future climate fluctuations and weather conditions, any of the action alternatives would provide fire managers with more flexibility to manage individual fires based on the values at risk and the potential for beneficial resource outcomes.

Alternative A shows the largest departure in effects related to fire because wildfire management zones are not included. However, because the fire-related direction is the same across the action alternatives (B, C, and D) there are no significant differences for fire and fuels management as analyzed. Variation occurs in the allocation of management area designations across the alternatives and how they are subsequently assigned to wildland fire management zones.

Effects on Fire Management from Timber Harvest

Timber harvest may have a short-term localized effect on fire management within individual timber sale areas with increased fine fuel loadings from slash accumulations, which could persist until the slash has decayed or decomposed. Over a broader scale, timber harvest can have some effect to fuel profiles and loading, especially in areas of spruce-fir with heavy spruce beetle mortality. Removing a large portion of the dead standing trees could substantially reduce the accumulation of surface fuels over the longer term (30–50 years) and could help moderate potential fire residence time and soil heating impacts from future wildland fires. These effects would still be localized and would likely affect only about 10 percent of the suitable timber base over a 20-year period.

Therefore, alternatives A, B, and C would result in more timber harvest, thus more distribution of slash and fine fuels across the treated areas. Prescribed burning can reduce the fuel load and prepare sites for regeneration (outside of lynx habitat).

Alternative D has more forested acres in a protected status than the other alternatives, resulting in reduced timber harvest and potential for slash. However, with less removal of the standing dead, beetle-killed trees, more will continue to decay and fall, resulting in large fuels accumulation that under hot, dry conditions could fuel a wildfire. Firefighter safety is of utmost importance when suppressing wildfires. Large amounts of downed dead wood combined with standing dead trees create conditions that can be extremely hazardous to firefighters and limits suppression strategies.

Effects on Fire Management from Road Management

Effects from road construction or reconstruction would have a minimal effect on fire management. Short-term delays or limited areas of access could impact emergency response to wildland fire incidents, but these occurrences would be rare. The extent to which these effects would vary across the alternatives is unknown.

Decisions that limit motorized access to areas of the Forest could have minor impacts on emergency response to wildland fire incidents. These could be mitigated on individual wildland fires by using alternate means of access, i.e., helicopters, or by employing different fire management strategies.

Effects on Fire Management from Designation of Wilderness

Effects for the acreage of recommended wilderness in alternative D would increase the acreage included in the resource restoration wildland fire management zone, but this would have minimal overall effect to fire management.

Effects on Fire Management from Designation of Research Natural Areas

Effects for the potential increased acreage of research natural areas in alternative D would increase the acreage included in the resource restoration wildland fire management zone. This would have minimal overall effect to fire management.

Cumulative Effects

Since they were developed, these national level plans, initiatives, and acts (called "other plans" for the rest of this discussion) have influenced the vegetation and fuel management programs on the Forest. In general, these plans have resulted in more vegetation treatments occurring in the wildland-urban interface to reduce hazardous fuels, and fewer vegetation treatments conducted in areas further from communities. In addition, the types of fuel treatments being used in response to these other plans are typically more expensive, and social issues, such as effects on scenery, air quality, noise, wildlife viewing, etc., can be more contentious. Therefore, increased public involvement, planning, and implementation expenses would lead to fewer acres treated within a given budget level. Not only do these other plans emphasize the need to reduce hazardous fuels in the wildland-urban interface, they also stress the need to restore natural fire regimes and forest conditions to the larger National Forest System landscape. These plans encourage the development of more resistant and resilient forest vegetation that would be less susceptible to large disturbances such as wildfires or insect outbreaks.

For the last several decades, more human development has occurred around the edges of National Forest System lands. This trend is expected to continue in the future and is likely to have similar effects on the forest vegetation to those discussed in the preceding paragraph. With a greater number of people living and recreating in these wildland-urban interface areas, there is a greater probability of more human-caused wildfire ignitions that could affect the forest vegetation, in spite of suppression efforts.

Working cooperatively with neighboring landowners on the management of fire and implementing fuels management strategies is effective, because it is the small lot owner that becomes the focus of suppression resources when large wildfires occur. The future increase in small lot owners would continue to challenge wildfire management during large fire events. Individually working with these property owners is costly and creates a patchwork of defensible properties intermingled with less defensible properties.

The current trend of rural volunteer fire department staffing is on the decline, leading to limitations on their ability to support fire suppression and structure protection. This could lead to increased spread of fire from outside the Forest.

The use of fire to maintain or restore fire-adapted ecosystems, or reduce hazardous fuels in the wildland-urban interface, is dependent upon air quality regulations. Increasing regulations over time have decreased opportunities for prescribed burning. More stringent air quality regulations regarding the quantity and timing of smoke emissions would result in substantial effects on using these tools. Further restrictions would impact the ability to make meaningful improvements in forest and fuel conditions and meet resource objectives using fire.

The cumulative effects of timber harvest, road management, wilderness, and other designated areas is expected to be minimal.

Carbon Stocks and Sequestration

Overview

There are no applicable legal or regulatory requirements or established thresholds concerning management of forest carbon or greenhouse gas emissions. Agency guidance on climate change in the National Environmental Policy Act is contained in documents from 2009 and 2010: *Climate Change Considerations in Project Level NEPA Analysis* (USDA Forest Service 2009) and *Climate Change Considerations in Land Management Plan Revisions* (USDA Forest Service 2010). The 2012 Planning Rule also requires a baseline assessment of carbon stocks. Carbon emissions from internal agency business operations are inventoried annually per Executive Order 13514 and reported to the USDA.

The Forest Carbon Management Framework takes advantage of corporate Forest Service monitoring data, management records, and management tools, complemented with forest change information from the Landsat series of satellites, to provide forest-level assessments of the impact of different kinds of disturbance on ecosystem carbon storage. A customized version of this framework was used to compare carbon storage differences across the four alternatives. Additional information about this framework is contained in the draft *Assessment of the Influence of Disturbance, Management Activities, and Environmental Factors on Carbon Stocks, Rocky Mountain Region* (USDA Forest Service 2016a).

Affected Environment

The Forest Service recognizes the important role that forest carbon sequestration plays in mitigating greenhouse gas emissions. Plants remove carbon dioxide from the atmosphere and store it through photosynthesis. Forests are important carbon sinks and generally remove more carbon dioxide from the atmosphere than they emit (Pan et al. 2011). Carbon uptake by forests in the United States offsets about 13 percent of our national carbon dioxide emissions each year (U.S. Environmental Protection Agency 2013). However, the Forest, and other Western forests, may emit greater amounts of carbon dioxide if wildfire and insect disturbances increase as expected, due to climate change and other stressors (Vose et al. 2012).

Reductions in carbon stocks may be slowed through forest protection and conservation strategies that retain forest land from conversion to non-forest uses, such as agriculture or development. This is more often associated with private land management, rather than federal lands that are generally protected and sustainably managed. Long-term forest management can help restore and maintain resilient forests that are better adapted to a changing climate and other stressors.

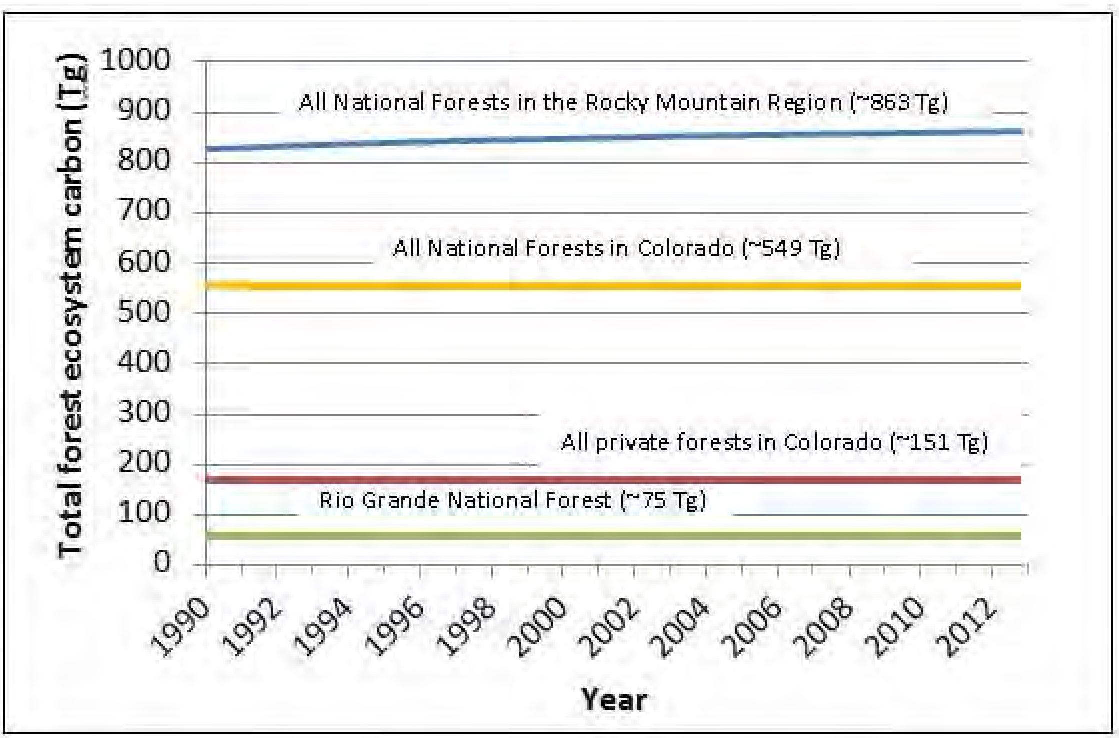
Wood products are also important when considering carbon benefits from forests. Forest restoration and other treatments that generate wood products, such as lumber and furniture, transfer ecosystem carbon to the harvested wood products pool. Using wood for building materials, instead of concrete, steel, or plastic, can have an overall carbon benefit. Forest vegetation treatments also generate excess material (woody biomass), which can displace tradition fossil fuels.

Ecosystem Carbon

The Forest Service has developed forest carbon assessment whitepapers for each region and national forest. The Forest's carbon assessment is based on forest inventory and analysis data and uses a baseline of 1990 to 2013. As part of this process, assessment data for the Forest have been disaggregated from the national inventory.

The carbon assessment does not include emissions from Agency, contractor, or permittee business operations or public recreation uses. Only forest ecosystem carbon stocks and harvested wood product pools are included in this assessment, consistent with U.S. Environmental Protection Agency reporting categories and availability of data. Carbon emissions from internal, agency business operations are inventoried annually per Executive Order 13514 and reported to the Department of Agriculture.

The Forest contains about 75 teragrams of total forest ecosystem carbon. One teragram is equivalent to 1,000,000,000 kilograms, or 1,000,000 metric tons. This has increased slightly over the duration of the Forest Inventory and Analysis Program samples from 1990 to 2013. To put this in context, all national forests within Colorado contain approximately 549 teragrams of carbon, and all national forests in the Rocky Mountain Region (Colorado, Nebraska, South Dakota, and parts of Wyoming) contain an estimated 863 teragrams. Total carbon in national forests in the Rocky Mountain Region has increased slightly from 829 teragrams in 1990. All private forests in Colorado have approximately 151 teragrams (measurement from 2014, but displayed on the graph below (Figure 10) for comparison purposes).



(All data were derived from the Forest Inventory and Analysis Program.)

Figure 10. Selected categories of total ecosystem carbon by ownership

Total forest ecosystem carbon (in all seven pools) stored in the Rocky Mountain Region has increased between 1990 and 2013. The assessment combines carbon stocks from seven different carbon pools including 1) above-ground; 2) below ground; 3) standing dead; 4) understory; 5) down dead; 6) forest floor; and 7) soil carbon, as defined in Assessment 4 (USDA Forest Service 2016b) and USDA Forest Service (2015).

Regionwide, the amount of carbon (teragrams) stored in the above-ground, standing dead, down dead, forest floor, and soil organic carbon pools increased from 1990 to 2013 (Figure 11). The above-ground pool stores the highest amount of carbon as compared to the other pools.

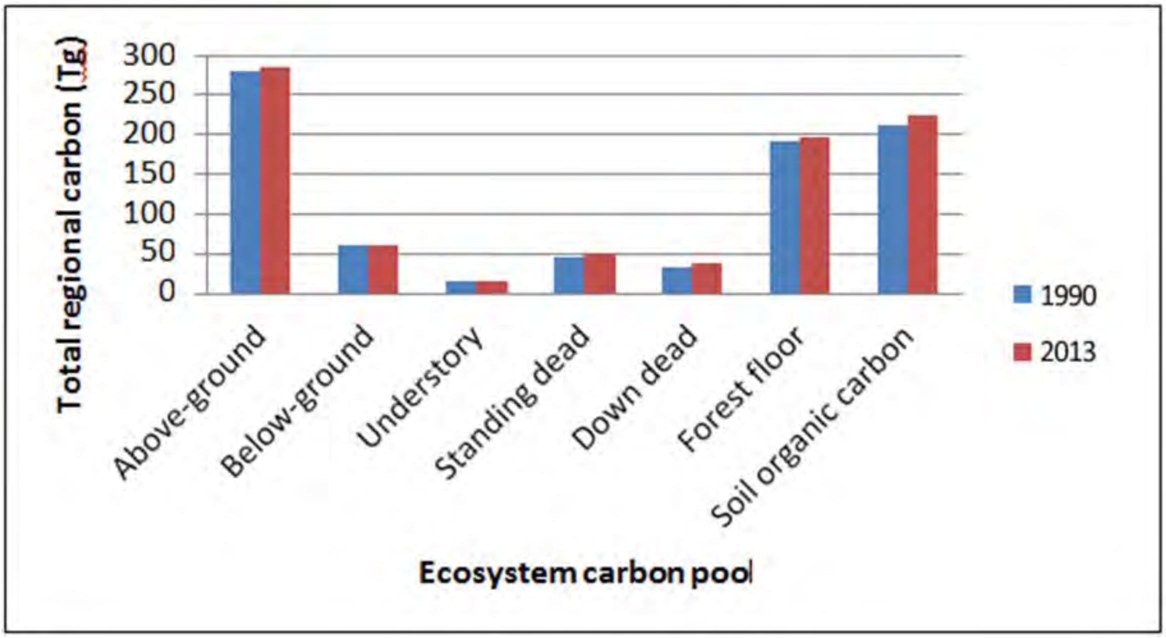
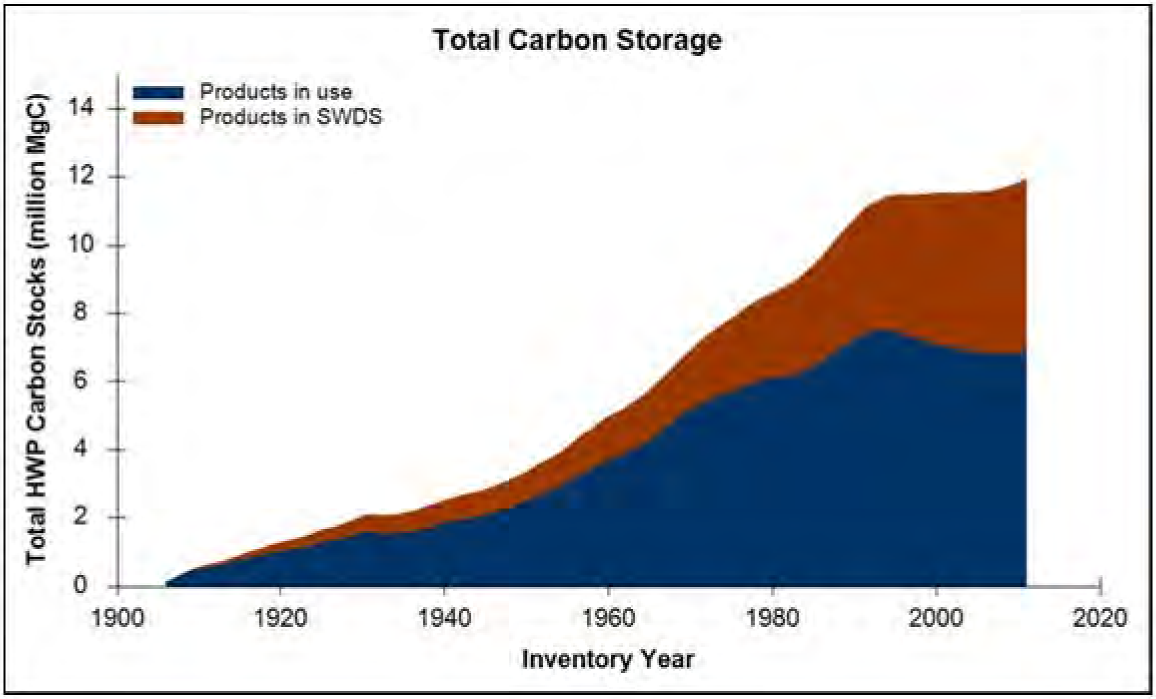


Figure 11. Carbon stocks in the seven forest ecosystem pools in National Forest System lands of the Rocky Mountain Region for 1990 and 2013

Harvested Wood Products in the Rocky Mountain Region

Nationwide, an estimated 5 percent of forest carbon stocks are contained in harvested wood products. Although the amount of harvested wood products is small as compared to ecosystem carbon, it is an important component of national level carbon accounting and reporting. As defined by the Intergovernmental Panel on Climate Change, harvested wood products are products made from wood including lumber, panels, paper, paperboard, and wood used for fuel (Skog 2008). The harvested wood products carbon pool includes both products in use and products that have been discarded to landfills, or solid waste disposal sites. Emissions from harvested wood products occur through decay and combustion of wood products.

For the Rocky Mountain Region, carbon stored in harvested wood products increased in the early 1950s until plateauing in 2005 and peaking in 2013 with about 12 teragrams. In the context of total forest carbon, including both ecosystem carbon and harvested wood products carbon, the carbon stocks of wood products harvested from the Rocky Mountain Region represent about 1.37 percent of total forest carbon storage associated with national forests in the Rocky Mountain Region in 2013 (Figure 12).



(Carbon in harvested wood products includes both products that are still in use and carbon stored at solid waste disposals sites, including landfills and dumps (Stockmann et al. 2014). A megagram (Mg) is equivalent to a metric ton.)

Figure 12. Carbon stored in harvested wood products manufactured from Rocky Mountain Region timber

The Future of Western Forest Carbon Stocks

The future of the terrestrial carbon sink of Western forests, including the Rio Grande National Forest, is uncertain due to the multiple interacting factors that influence carbon stocks and fluxes (Lenihan et al. 2008a, King et al. 2007, Pacala et al. 2007, Birdsey et al. 2007). These factors include climate variability and change; potential positive effects of increased atmospheric carbon dioxide concentrations on plant productivity; frequency, duration, and severity of moisture stress; changes in the rate and severity of natural disturbances; and land management practices (Canadell et al. 2007). The current spruce beetle outbreak is one example of a large disturbance affecting the Forest's carbon stocks.

Modeling experiments based on projected changes in climate suggest that the future strength of the United States carbon sink is very sensitive to the degree of change in climate, particularly precipitation, and fire regimes (Bachelet et al. 2001; Lenihan et al. 2008b). If precipitation increases and temperature increases are small or moderate, carbon stocks are expected to increase. Conversely, if climate changes result in decreased precipitation and soil moisture during the growing season, this may result in a net carbon source to the atmosphere (Lenihan et al. 2008b). Increasing concentrations of atmospheric carbon dioxide may moderate these impacts by enhancing vegetation productivity and water use efficiency, at least up to a point (Bachelet et al. 2001; Joyce and Nungesser 2000; Lenihan et al. 2008a; Fischlin et al. 2007). Increases in annual area burned may further reduce carbon stocks despite the potentially positive effects of increasing carbon dioxide concentrations (Lenihan et al. 2008b).

Growth rates may increase in high-elevation forests during years with earlier spring snowmelt, increased summer precipitation, abnormally warm annual temperatures, and longer growing seasons. This suggests that projected changes in regional climate will likely result in increased productivity and carbon stocks of high-elevation forests, which make up a large portion of the Forest.

Prolonged periods of water stress significantly reduce a tree's ability to photosynthesize (Kozlowski and Pallardy 1997). As a result, climate projections with increased frequency of reduced snowpack, earlier spring snowmelt, increased temperatures during the growing season, and little or no significant increase in summer precipitation likely will result in reduced forest productivity and carbon sequestration (Boisvenue 2007; Boisvenue and Running 2010, Hu et al. 2010). Recent research suggests that regional warming and water balance deficit trends over the late 20th century are contributing to rapid and widespread increases in mortality rates and slight decreases in forest density and basal area in old growth forest throughout the Western United States (van Mantgem et al. 2009).

Direct and Indirect Effects

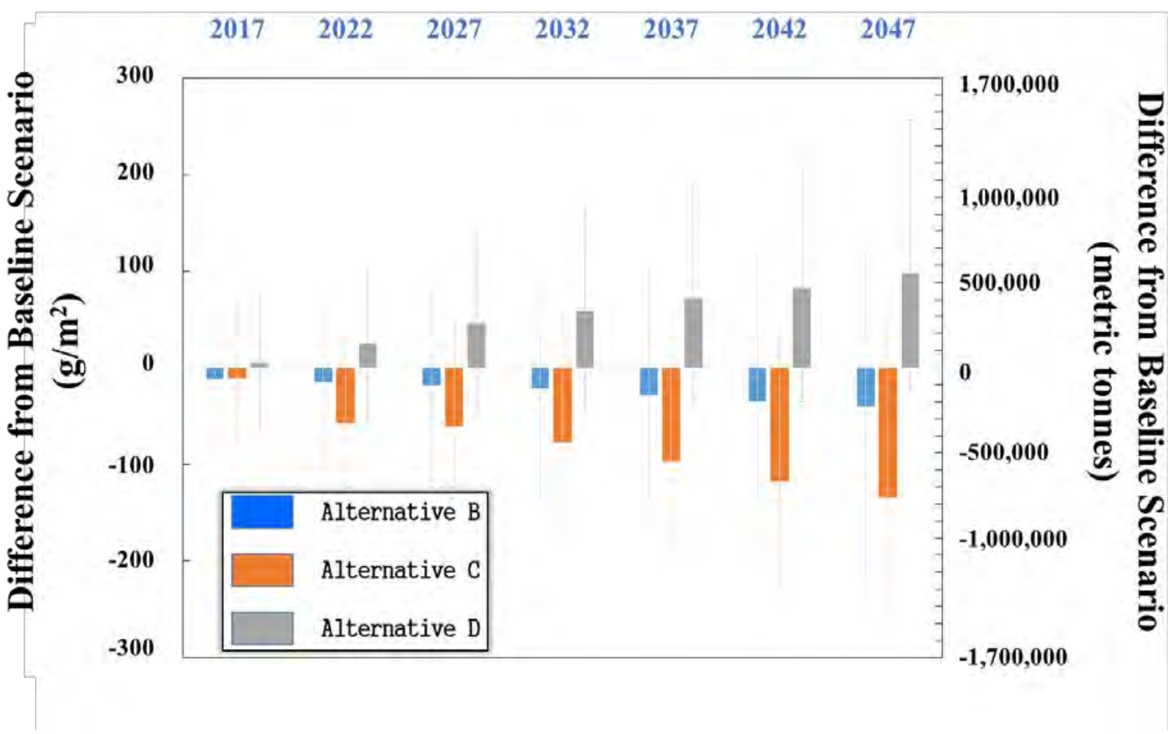
The Forest Carbon Management Framework (ForCaMF) was adapted to simulate the carbon storage consequences of four management alternatives proposed for the Forest. Details of those alternatives are described in Table 29, Table 30, Table 31, and Table 32. Alternative A was considered the baseline because it is similar to what was done under the previous plan. Alternative B represented a slight increase in prescription burning in both the first and second decades. Alternative C likewise involved slightly more aggressive prescription burning and a near doubling of the salvage harvest rate. Alternative D involved about the same level of prescription burning as the baseline, but a nearly 50-percent decrease in salvage harvesting.

ForCaMF (Healey et al. 2014, 2016; Dugan et al. 2017) was used in work sponsored by the Forest Service Office of Sustainability and Climate Change to provide uniform assessments across all National Forest System planning units of the relative impact of different types of disturbance on carbon storage since 1990. In this forward-looking analysis, ForCaMF was used to characterize likely carbon storage (with 95-percent confidence intervals) under each proposed alternative. Several points to keep in mind for this analysis:

- Average Rio Grande fire effects during 1990–2011 were simulated into the future. Mean fire effects were characterized as part of the Forest Service Office of Sustainability and Climate Change-baseline carbon analyses mentioned above. Relative to some other national forests in the Forest Service Rocky Mountain Region, effects from fires on the Forest were relatively light.
- No difference in fire occurrence was simulated among the alternatives.
- Recent insect outbreaks are considered in the analysis, and all salvage harvests were directed toward stands hit by those outbreaks. Stands not salvaged were subjected to normal post-insect decay and recovery dynamics.

- No further insect activity was simulated past 2017.
- Analysis appropriately simulates transition from live to dead carbon pools as well as realistic decay rates, as specified by the Forest Vegetation Simulator (Raymond et al. 2015). Effects do not include changes in soil pools.
- The analysis counts only carbon in the forest ecosystem. It does not count potential temporary storage of carbon in harvested wood products, nor does it include fossil fuel emissions related to forest operations.

Projected carbon storage differences in the Forest for alternatives B through D ***in relation to*** the storage projected under alternative A are shown in Figure 13. In other words, positive numbers in Figure 13 indicate how much more carbon would be stored over time under the given alternative compared to alternative A, and negative numbers indicate how much less carbon would be stored in relation to alternative A. Error bars represent an empirical 95-percent confidence interval resulting from the range of answers returned when we simulate all known error sources 500 times (also known as Monte Carlo Analysis). Given the above assumptions, alternatives B and C involved less carbon storage over the next 30 years than alternative A, while alternative D led to more storage. Carbon storage effects are presented both in grams per square meter and also in terms of total carbon storage across the entire Forest.



Alternative A is represented by the zero line. Error bars represent empirical 95-percent confidence intervals, given the assumptions about future fire and insect occurrence listed previously.

Figure 13. Carbon storage differences among alternatives, as quantified against storage patterns related to the baseline management scenario (alternative A).

According to earlier reports based on the Forest Inventory and Analysis Program data, total current carbon stocks in the Forest have remained at about 75 to 80 million metric tonnes

(75 to 80 teragrams) since the beginning of the reported period in 2005 (USDA Forest Service 2015) (Figure 10). Against the backdrop of an approximately carbon-neutral forest, the differences in carbon storage among the scenarios may play a role in whether the Forest is a source or sink. After 20 years (in 2037), for example, alternative D would result in carbon storage of approximately 955,000 metric tonnes more than alternative C (406,000 tonnes more than alternative A vs. 549,000 tonnes less than alternative A – see 2037 in Figure 13). This represents a difference of about 1.2 percent of the 75 to 80 million tonnes currently present. It is worth noting, however, that the standard error around the cited report's estimate of total carbon is about +/- 5 million metric tonnes. Also, the 95-percent confidence interval of this analysis shows that it is possible that alternative A may not actually produce any more or less carbon than alternatives C or D. Thus, while a difference among scenarios of nearly a million metric tonnes is large in absolute terms, it is not a large amount in relation to either the total stored by the Forest or the uncertainty of the monitoring system. Expanded natural disturbances likely would affect carbon storage in the Forest much more than the difference among any of these alternatives. ForCaMF analysis throughout the region has shown that both insect and fire patterns can account for much larger differences in carbon storage than the differential impacts of any of the proposed alternatives.

Cumulative Effects

Land-use conversions from forest to other uses is a key activity that negatively affects carbon stocks. Rio Grande National Forest lands in this plan would remain forest and would not be converted to other land uses, such as agriculture or development, and long-term forest services and benefits would be maintained. These lands would be protected and sustainably managed; over-harvesting of timber is not a primary concern for decreased carbon sequestration. Sustainable management practices and promotion of healthy, resilient forest ecosystems increase the ability of the Forest to provide long-term carbon sequestration services.

The impact of the alternatives and proposed forest plan direction on atmospheric concentrations of greenhouse gases or global warming is not likely to be large at the global scale, considering the global scale of the atmospheric greenhouse gas pool and the multitude of natural events and human activities contributing globally to that pool.

Over the long term (centuries), the effects of disturbances on the regional carbon balance are neutral, assuming that similar vegetation regrows on the disturbed area and the long-term frequency and severity of disturbances does not change. Cumulative effects would be small in relation to global capacity to sequester carbon. The net effects on forest health and carbon sequestration have a high degree of uncertainty, primarily because of uncertainty in the magnitude of future climate change, and the complex interactions of the forest with disturbances, changes in temperature and precipitation, and ecological processes.

Forest Products

Overview

The Forest contains valuable timber resources. Timber harvesting provides forest products that help support local wood processing industries and the communities associated with those industries. It helps meet the demands of the public for products such as lumber, houselogs, or other forms of roundwood. Timber harvests and thinning treatments are also an important tool in shaping the structure and composition of the forest, in order to meet ecological integrity and other objectives. Timber harvest may be used for improving wildlife habitat, making the forest more resilient to disturbances such as fire, insects, and disease, and improving tree growth.

Timber suitability was determined using various resource data and geographic information system data to apply criteria and identify lands suitable for timber production. Criteria for suitability are defined in the 2012 Planning Rule procedures at 36 CFR 219. 11 and Forest Service Handbook 1909. 12, chapter 60. The criteria used is defined in detail in Appendix B.

Timber harvest was modeled using the Forest Vegetation Simulator to estimate the sustained yield limit, as described in Appendix B.

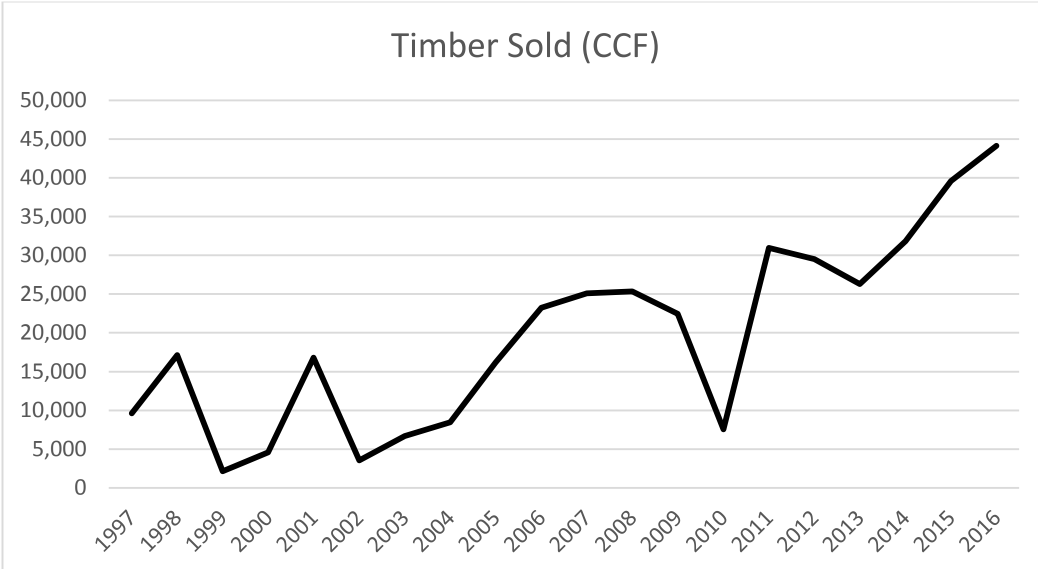
Planned treatment types and management levels were determined for each alternative, with volume estimated from historic data. Together, this information was used to determine the projected timber sale quantity and projected wood sale quantity for each alternative.

Affected Environment, Existing Conditions, and Trends

The purpose of a Forest Plan under the 1976 National Forest Management Act was originally a response to public concerns about timber harvest. The Act and subsequent Planning Rule sets specific requirements regarding timber harvest. The Planning Rule requires an estimate of the sustained yield limit of timber removed from the Forest. It also requires plan direction on the types of forest harvesting methods to be used, and the size and location of timber harvests. A forest plan does not authorize any timber harvest, but merely identifies what parts of the forest would be suitable or not suitable for timber production and harvest and what constraints might apply.

Although the Forest has an active forest management program, there are numerous areas where timber harvest and road building are prohibited or restricted. Currently, more than 900,000 acres (about one-half of the Forest) is in wilderness and roadless areas that are excluded from the “may be suitable” suitable timber base.

Currently, Forest timber is sold through timber sales and permits related to firewood and other products such as posts and poles. On average, over the last 5 years, an estimated 26,748 hundred cubic feet of sawtimber and 7,489 hundred cubic feet of other products by permit were sold each year for a total of about 34,000 hundred cubic feet a year. Since 1997, an estimated 347,090 hundred cubic feet of timber has been sold (Figure 14). In 2016, 2,308 acres of sawtimber was harvested, with an average of 1,811 acres of sawtimber harvested annually for the last 5 years (Table 36).



In CCF. Timber sold includes material sold through timber sales as well as permits for other products.

Figure 14. Total timber sold from 1997 through 2016

Table 36. Acreage of treated sawtimber, 2008–2016

Year	Treated Sawtimber (acres)
2008	1,303
2009	826
2010	148
2011	1,616
2012	1,675
2013	1,198
2014	1,759
2015	2,116
2016	2,308
5-year average	1,811

In southern Colorado, federal timber suppliers are the largest source of timber. The Forest is a supplier in the commercial forest products industry and supports mills both in and outside the San Luis Valley.

About one quarter (approximately 499,936 acres, 27 percent) of the 1.8 million acres that make up the Forest is identified as *may be suitable* for timber production (see the *Timber Suitability – May be Suitable for Timber Production* map, which is contained on the DVD located at the back of this document). Most of the area that *may be suitable* for timber production is in the spruce-fir (42 percent), aspen (23 percent), and mixed-conifer (22 percent) local cover types (Table 37). Even though lands may be suitable for timber production, they may not be feasible for timber production. Feasibility for timber production will be determined at the project level. Based on the *may be suitable* acreage, the estimated sustained yield limit is 7,374,937 cubic feet per year or 73,749 CCF per year.

A smaller subset of this area is considered suitable under each alternative and is described below.

Table 37. Acres that may be suitable for timber production, by local cover type

Local Cover Type	Acres	Percent
Aspen	116,036	23
Lodgepole Pine	22,199	4
Mixed-Conifer	108,948	22
Ponderosa Pine	19,872	4
Spruce-Fir	208,878	42
Other	24,003	5
Total	499,936	100

Timber harvest is allowed on land 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 of the area and is generally minimal.

In general, the market for timber in the Western United States is experiencing a prolonged decline from the decline in the housing market after the recession in 2008, which has caused wood product prices and production to drop. However, there is still capacity for expanding markets, such as small-diameter material and salvaged timber as biomass in the energy industry.

At a statewide scale, sawmills have closed in Colorado over the past several decades. Since 2000, five sawmills in Colorado have closed. Additional sawmills closed in the decade prior to that (Colorado State Forest Service 2009). All of these closures have resulted in possibilities for sawmill expansion in the San Luis Valley.

Several things drive the supply and demand for timber in the local area. First, supply is based on the Forest areas that can be harvested. Second, trends in the housing market drive demand. Third, timber budgets, which fluctuate markedly from year to year, greatly affect what can be supplied.

Because of the large-scale mortality due to spruce beetle, the Forest has been increasing timber sale volumes. Whether this increase can be sustained depends on how long the larger dead trees retain their utility as saw or house logs (Forest Stewardship Concepts, Ltd. 2014). As the larger dead trees decay, there may be a large volume of low-value material available. It may be difficult to find a market for this lower quality woody biomass.

Direct and Indirect Effects

Timber suitability under alternative A shows that approximately 320,567 acres are suitable for timber production (see the *Alternative A – Timber Suitability Is Suitable for Timber Production* map, which is contained on the DVD located at back of this document).

Timber suitability for the action alternative was determined using various resource data, including geographic information systems, to apply criteria and identify lands suitable for timber production. Criteria for suitability are defined in the 2012 Planning Rule procedures in 36 CFR 219. 11 and Forest Service Handbook 1909. 12, chapter 60.

Areas considered unsuitable for timber production include, but are not limited to, wilderness areas, Colorado roadless areas, research natural areas, areas with soil types having "high mass movement potential," areas with no reasonable assurance of adequate restocking, non-forest land, areas with nonindustrial species, riparian areas, wild, scenic, and recreational rivers, special interest areas, buffers along national scenic, historic, and recreation trails, backcountry areas, and the ski-based resort areas. The specific criteria used are defined in detail in Appendix B.

Suitable timber acreage for the alternatives is listed in Table 38. The suitable timber area for each alternative is shown in the *Timber Suitability maps for alternatives A, B, C, and D*, each of which is contained on the DVD located at the back of this document.

Table 38. Timber suitability by alternative

	Alternative A (acres)	Alternative B (acres)	Alternative C (acres)	Alternative D (acres)
Estimated Forest Total	1,837,000	1,837,000	1,837,000	1,837,000
Lands not suited for timber production due to legal or technical reasons	1,337,064	1,337,064	1,337,064	1,337,064
Lands that may be suited for timber production	499,936	499,936	499,936	499,936
Total lands suitable for timber production (timber production is compatible with the desired conditions and objectives established by the plan)	320,567	468,311	480,683	401,414
Total lands not suited for timber production	1,516,433	1,368,689	1,356,317	1,435,586

Two main timber suitability differences in alternative A pertain to the grassland resource production and bighorn sheep management areas. The grassland resource production management areas are being considered suitable for timber production in alternatives B, C, and D, a change from alternative A, where they are not suitable. In addition, the bighorn sheep management areas in alternative A were merged with winter range to create the big game winter range management areas in alternatives B, C, and D. As a result, these areas are now considered suitable for timber production.

The land that is suitable under alternatives B, C, and D varies mostly due to recommended wilderness and special interest areas. These proposed areas are highest under alternative D, which has the lowest amount of suitable timber acres accordingly. These proposed areas are lowest under alternative C, which has the highest amount of suitable timber acres.

In general, plan direction is reduced and simplified in alternatives B, C, and D, relative to alternative A. The desired condition included in all action alternatives describes the desired acreage percent by vegetation type for the various structural stages, including old forest. As previously mentioned, minimum stocking requirements vary between alternative A and the action alternatives. This change would result in lower stand density, which would increase resilience to stressors including climate change, insects, and disease.

Forest plan desired conditions for non-timber forest products for alternatives B, C, and D were adjusted but would have similar intent and effects as under alternative A. There are also some other additional plan components for non-timber forest products related to oshá and special forest products for tribal use that are included in alternatives B, C, and D, but not in alternative A. These additional plan components would not have any effects.

Projected timber sale and wood sale quantities for each alternative are listed in Table 39, Table 40, and Table 41. Conversion factors used include 4.4 board feet per cubic foot for mixed-conifer and ponderosa pine and 5 board feet per cubic foot for the spruce salvage sales. Under all alternatives, volume may not be evenly distributed over the time period but may be higher during the initial years of the time period and lower during the later years of the time period.

Table 39. Planned timber sale program (annual average volume output) for alternatives A and B, based on average base funding and an estimated sustained yield limit of 73.7 MCCF

	Timber Sale Program 1st Decade		**Timber Sale Program 2nd Decade**	
Alternatives A and B	**CCF**	**MBF**	**CCF**	**MBF**
Timber Products	*Does not include salvage or sanitation volumes.*			
Lands suitable for timber production				
A1. Sawtimber	490	215.6	5,880	2,587.2
A2. Other products	210		2,520	
C. Projected Timber Sale Quantity (A1 + A2)	700	215.6	8,400	2,587.2
Other Estimated Wood Products	*Does not meet timber product utilization standards.*			
	CCF	**Tons**	**CCF**	**Tons**
D. Fuelwood	7,200	8,600	7,200	8,600
E. Projected Wood Sale Quantity (C + D)	7,900		15,600	
	CCF	**MBF**	**CCF**	**MBF**
F. Estimated Salvage Volume	32,100	16,050	0	0
G. Total Volume including Salvage (E + F)	40,000		15,600	

Table 40. Planned timber sale program (annual average volume output) for alternative C, based on average base funding plus supplemental funds and an estimated sustained yield limit of 73.7 MCCF

	1st Decade – Years 1 – 6		1st Decade – Years 7 – 10		2nd Decade	
Alternative C	**CCF**	**MBF**	**CCF**	**MBF**	**CCF**	**MBF**
Timber Products	*Does not include salvage or sanitation volumes.*					
Lands suitable for timber production						
A1. Sawtimber	0	0	10,500	4,620	10,500	4,620
A2. Other products	0		4,500		4,500	
C. Projected Timber Sale Quantity (A1 + A2)	0	0	15,000	4,620	15,000	4,620
Other Estimated Wood Products	*Does not meet timber product utilization standards.*					
	CCF	**Tons**	**CCF**	**Tons**	**CCF**	**Tons**
D. Fuelwood	7,200	8,600	7,200	8,600	7,200	8,600
E. Projected Wood Sale Quantity (C + D)	7,200		22,200		22,200	
	CCF	**MBF**	**CCF**	**MBF**	**CCF**	**MBF**
F. Estimated Salvage Volume	62,800	31,400	0	0	0	0
G. Total Volume including Salvage (E + F)	70,000		22,200		22,200	

Table 41. Planned timber sale program (annual average volume output) for alternative D and an estimated sustained yield limit of 73.7 MCCF

	1st Decade		2nd Decade	
Alternative D	**CCF**	**MBF**	**CCF**	**MBF**
Timber Products	*Does not include salvage or sanitation volumes.*			
Lands suitable for timber production				
A1. Sawtimber	350	154	2,800	1,232
A2. Other products	150		1,200	
C. Projected Timber Sale Quantity (A1 + A2)	500	154	4,000	1,232
Other Estimated Wood Products	*Does not meet timber product utilization standards.*			
	CCF	**Tons**	**CCF**	**Tons**
D. Fuelwood	7,200	8,600	7,200	8,600
E. Projected Wood Sale Quantity (C + D)	7,700		11,200	
	CCF	**MBF**	**CCF**	**MBF**
F. Estimated Salvage Volume	17,300	8,650	0	0
G. Total Volume including Salvage (E + F)	25,000		11,200	

The projected sale quantities and project salvage volume is highest under alternative C and lowest under alternative D. In alternatives A, B, and D, the focus of the vegetation management program would be on salvage harvesting spruce-fir areas that have high mortality due to spruce-beetle for the first decade, then transitioning to thinning/restoration treatments and uneven-aged management in the ponderosa pine and mixed-conifer vegetation types, along with possible aspen harvests. In alternative C, the vegetation management program would be similar, but with a focus on more intensive salvage harvesting in the beetle-killed spruce-fir areas for a shorter time period (6 years, before transitioning to thinning/restoration treatments, uneven-aged management, and shelterwood harvests in the ponderosa pine and mixed-conifer types, along with possible aspen harvests. The planned vegetation management activities are listed in Table 29, Table 30, Table 31, and Table 32.

Effects on Forest Products from Fire Management

As described in the *Fire Management* section, some management areas under alternative A require full suppression of fires while alternatives B, C, and D allow fire managers more flexibility in deciding how to manage individual fires, which allows fire to play a larger and more natural role across the landscape. If some fires are allowed to burn, particularly in this management area, it may have a small impact on timber volume available for harvest. In general, this difference among alternatives will be negligible in that areas where there is the most flexibility on allowing fires to burn are predominantly roadless and wilderness areas that are already outside of the suitable timber base. Also, human-caused wildfires will be managed under a full suppression strategy commensurate with the values at risk.

Effects on Forest Products from Wildlife Management

The main effects from the wildlife management program are related to the lynx management direction. Alternatives B, C, and D add plan components in addition to the direction from the Southern Rockies Lynx Amendment. These plan components better incorporate the existing landscape condition in the spruce-fir forest ecosystem. Alternatives B and D also contain additional lynx-related management approaches as well as a change in direction for regeneration harvest. Collectively, these change what constitutes suitable and unsuitable habitat given the effects of the spruce beetle outbreak and make a small addition to what counts toward requirements in the Southern Rockies Lynx Amendment direction.

The effect of the lynx direction in alternatives B, C, and D is hard to discern at this point. Overall, the Southern Rockies Lynx Amendment, as implemented, has had an effect on the timber program and has changed the philosophy on vegetation management and the silvicultural practices used. The Southern Rockies Lynx Amendment focuses on uneven-aged management in lynx habitat areas in live timber stands. In the past, acres have been deferred from harvest due to the presence of high-quality lynx habitat, and this amount has varied by project. Similar to current direction, the supplemental direction is expected to provide guidance that supports vegetation management in lynx habitat while providing a focus on the attributes important to the conservation, recovery, and viability of the species in a landscape affected by the spruce beetle outbreak. Protection of lynx habitat would continue to be emphasized in the action alternatives.

Management approaches proposed in alternatives B and D relate to using available science, data, and analysis to determine if limits in the existing direction have been met, how suitable and unsuitable lynx habitat is defined, placement of snag clumps, connectivity in lynx habitat areas, and considerations related to lynx denning areas. Direction also specifically adds pre-commercial thinning to the list of silvicultural treatments that may change the structural stage or remove horizontal cover, and therefore count toward the treatment caps in the Southern Rockies Lynx Amendment direction. Lastly, there is an additional objective related to the reduction of adverse highway effects on lynx. These plan components would have a small effect on the forest products program, with potentially a slight increase in the amount of acres deferred from harvest due to lynx habitat concerns, given the constraints already in place under Southern Rockies Lynx Amendment that have been incorporated into all alternatives.

In addition, there may be a small effect on the forest products program from the snag-related plan components. In all alternatives, a small amount of volume may not be harvested due to leaving snags for wildlife habitat and other ecosystem objectives.

Effects on Forest Products from Recreation Management

The action alternatives (B, C, and D) differ from the no-action alternative by including additional management direction for congressionally designated trails, including the Continental Divide National Scenic Trail and the Old Spanish National Historic Trail. Under alternatives B, C, and D, these trails were removed from the suitable timber acreage along with a one-half-mile buffer on each side of the trail. This has a small effect on the suitable timber acreage since some, but not all, of this area would have been in the suitable timber acreage otherwise. The management direction for these areas is also more restrictive in terms of the type of vegetation management that can be done (for reasons other than timber production).

Cumulative Effects

Programmatic planning efforts occurring adjacent to the Forest include:

- Plan development for the Rio Grande del Norte National Monument
- Carson National Forest land management plan revision
- Grand Mesa, Uncompahgre, and Gunnison National Forests land management plan revision
- Revision of the Rio Grande County land use master plan.

Many factors influence and affect 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 Forest. Budgets and court decisions also impact timber supply potential. Following is a brief description of some items that are changing or may change in the future, adding to the effects on timber harvest from the alternatives.

The demand for timber products is a driver in the amount of timber supplied. If markets improve and demand for wood products increases, there would be more desire for timber from the Forest. Alternatively, if demand decreases and sawmills close, there may be less desire for timber from the Forest. A decrease in demand may reduce the amount of timber sold from the Forest under all alternatives.

The supply of timber from private and state lands and adjacent national forests impacts the demand from the Forest. If timber supplies decreased from private and state lands and adjacent national forests, there would be an increase in demand for timber. If supplies increased from private and state lands and adjacent national forests, there may be a decrease in demand for timber from the Forest. A decrease in demand may reduce the amount of timber sold under all alternatives.

The effects of past, present, and reasonably foreseeable future actions are difficult to assess due to the variations in demand for forest products. Cumulative effects are not expected to decrease or increase from the current trends.

Nonforested Ecosystems

Existing conditions

The Final Environmental Impact Statement for the Revised Forest Land and Resource Management Plan (USDA Forest Service 1996) addressed land type associations that subdivided habitat based on similarities in geology, soils, and plant associations. In preparation for revising the forest plan, Assessments 1 and 3 (USDA Forest Service 2016) addressed existing data related to ecosystem integrity, systems drivers and stressors for terrestrial ecosystems. The assessments considered terrestrial ecosystems by grouping them into forested, nonforested, and alpine ecosystems. Forested ecosystems include spruce-fir, mixed conifer-wet, mixed conifer-dry, Pinyon-juniper woodlands, Rocky Mountain Gambel oak, and southern Rocky Mountain montane riparian, which are discussed in the *Forested Ecosystems* section.

Nonforested ecosystems identified in the assessments include Rocky Mountain alpine turf, southern Rocky Mountain montane-subalpine grassland, sagebrush shrubland, and inter-mountain basins greasewood flat (Table 42).

Table 42. Modeled nonforested ecosystems

Ecosystem	Percent of Forest[1]
Rocky Mountain Alpine Turf	11
Southern Rocky Mountain Montane-Subalpine Grassland	18
Sagebrush Shrubland	Less than 1
Intermountain Basins Greasewood Flat	Less than 1

[1] Based on 1,731,592-acre total estimated from Rio Grande National Forest – Assessments 1 and 3 Ecosystems Integrity, Systems Drivers, and Stressors for Terrestrial Ecosystems (p. 8).

Assessments were prepared in preparation for revising the forest plan. The information from Assessment 1 and 3 – Ecosystem Integrity Drivers and Stressors for Terrestrial Ecosystems is hereby incorporated by reference.

The Rocky Mountain alpine turf ecosystem is prevalent above timberline on the Forest, generally above 11,000 feet in elevation. Dominant species include boreal sagebrush, several species of sedge, tufted hair grass, fescue species, phlox, and clover. These high-elevation species experience intense sunlight, cooler temperatures, and high winds in a short growing season. Shallow soils are evidenced in rocky outcrops and talus slopes interspersed with alpine turf. These ecosystems typically include alpine fell-fields, dwarf willow, turf, and wetlands.

These habitats have been used for domestic sheep grazing for many years. Past grazing practices have influenced the current conditions of these ecosystems. Over time the number of high-elevation sheep allotments in use and the numbers of sheep using the active allotments have been reduced. Reductions in the recent past are often tied to the need to reduce the likelihood of interactions between domestic sheep and bighorn sheep. This is discussed further in the *Range Management* section. Other uses in this ecosystem include mining and recreation.

Dominant species in the southern Rocky Mountain montane-subalpine ecosystem include Thurber fescue, Arizona fescues and other grasses, forbs, and sedges. This ecosystem generally ranges in elevation from 7,000 to 10,000 feet along the elevated plains, hills, valleys, and mountain side slopes. Past grazing influences are apparent in these ecosystem on all but the steepest ground.

In addition to livestock grazing, native ungulates graze these areas as they migrate through. Fire regimes vary and are correlated with the surrounding forested ecosystems. Fire regimes are characterized as more frequent and of lower severity at the lower-elevation Arizona fescue habitat, and become less frequent but more severe as elevation rises to the Thurber fescue habitat, which occurs at higher elevations (Romme et al. 2009).

Few acres of the dry sagebrush shrubland ecosystem occur on the Forest. The majority of this ecosystem occurs adjacent to the Forest in the northern portions of the San Luis Valley. Grazing and fire suppression have impacted plant composition in these ecosystems. Understories were historically composed of bunch grasses and forbs.

Similar to dry sagebrush shrubland, intermountain basin greasewood flat habitats occur mostly adjacent to the Forest and occupy a few acres at the lowest elevations. Past grazing practices influenced these understory plant compositions.

Range Management

Background

Livestock grazing has been an important part of the local economy and part of the cultural fabric of the San Luis Valley and the surrounding area for more than a century. Establishment of the San Juan Forest Reserve, predecessor to the current Forest, in 1905 led to many changes to grazing practices over time.

Current range conditions are largely a reflection of past practices. Historic stocking rates for both cattle and sheep were much higher prior to the establishment of the Forest. It has been estimated that more than 150,000 head of sheep grazed the Conejos Ranger District (not including the northern part of the district). Permitted sheep numbers now range from 5,000 to 6,000 head.

Historic grazing also occurred for longer periods than current practices. Animals were permitted access as early as April and often remained on National Forest System lands through the end of October. Currently the average date for entry on to the unit is June 1, and most exit dates do not exceed September 30. Use by cattle followed a similar pattern. Many allotments contained more than 1,000 head of cattle, while today allotments carry a more sustainable number.

The livestock industry began in the southern San Luis Valley in the late 1700s. Livestock were brought from northern New Mexico to summer on the valley floor. Grazing of lands that are now national forest were first documented in Raton Park in 1856.

The Forest began to control and document livestock grazing in about 1910. Livestock numbers and seasons of use have decreased from approximately 500,000 animal unit months in 1920 to 87,456 animal unit months today.

There are currently fewer permittees than in the past. For example, the Cumbres-La Manga Cattle and Horse Allotment on the Conejos Peak Ranger District had 58 permittees in 1935. In 2016, there were only 11 members of the Cumbres-La Manga Cattle Association. Tracing the exact history of the individual permits is challenging. Some families have consistently run livestock on what now makes up the Forest since the 1880s.

Decreases over time resulted from bringing livestock numbers and management into compliance with estimated capacities as well as changes in agriculture operations in the valley. Sheep production has a smaller presence on National Forest System lands than in the past and is expected to experience further decreases in the future.

Today’s grazing and range management program focuses on ecological integrity and sustainability, which will allow for productive lands that are capable of sustaining grazing and other forest uses into the future.

Rangelands include all land producing, or capable of producing, native forage for grazing and browsing animals, and lands that have been revegetated naturally or artificially to provide a forage cover that is managed like native vegetation. Rangelands include grasslands, forb lands, and shrublands; and those forested lands that can, continually or periodically, naturally or through management, support an understory of herbaceous or shrubby vegetation that is available for grazing or browsing animals.

Livestock grazing is permitted on suitable rangeland under almost all existing management areas prescriptions. Grazing is limited in research natural areas and is not allowed in ski-based resort areas. Areas that are suitable and capable for livestock are identified in the forest plan, and direction specific to rangeland management is assigned. A 2002 suitability determination found that an estimated 31 percent of the Forest is suitable for grazing; this equates to approximately 581,556 acres. The present analysis assumes no change from the 2002 determination for lands suitable for range management.

Rangeland suitability and capability are closely connected. Rangeland capability must be analyzed and established before a suitability determination can be made. Projected capacity for livestock grazing is 143,000 head months, which includes grazing for both cattle and sheep. Maps showing *Grazing Allotments* and *Range Capability* are contained on the DVD located at the back of this document.

Livestock grazing influences ecological processes such as the water cycle, nutrient cycling, energy flow, and community dynamics. Activities related to livestock grazing can impact species through habitat disturbance, modification, or loss of individuals by grazing or trampling. Past grazing practices altered plan composition and density through unmanaged grazing practices, which caused long-lasting environmental effects. There is still evidence of these effects on the landscape but, for the most part, ecological integrity and diversity of vegetation has rebounded over time by applying proper stocking and modern range management techniques.

The number of cattle grazing permits, allotments permitted, and forage consumption (animal unit months) is relatively the same as was considered in the 1996 forest plan analysis (USDA

Forest Service 1996). Sheep grazing has been reduced over time. The overall decline of the wool growing industry, changes in permittee operations, regional drought conditions, and access have challenged operators to remain economically viable in some locations. However, there is strong demand for sheep grazing permits in recent years as young ranchers are getting into the business or taking over the family business, and the market has been good for the last several years. The decline in permitted sheep grazing on the Forest in recent years is due to conflicts with bighorn sheep herds.

Some domestic sheep allotments on the Forest are located in and near occupied range and suitable range of Rocky Mountain bighorn sheep. There is a potential risk of contact occurring between domestic sheep and Rocky Mountain bighorn sheep. Research shows that contact between bighorn sheep and domestic sheep and goats can lead to respiratory disease and fatal pneumonia in bighorn sheep and potentially affect the viability of a population of bighorn sheep. To promote healthy, viable populations of bighorn sheep, domestic sheep stocking and distribution should be managed to minimize risk of contact with Rocky Mountain bighorn sheep.

The complexities, disease history, and mechanisms or causal agents leading to epizootic disease events are still not fully understood in the wild. The best available science suggests that maintaining spatial or temporal separation of the species is a prudent step when the management objective is to maintain bighorn sheep populations. Three letters of national direction issued from the office of the Deputy Chief of the Forest Service (Holtrop letter, August 19, 2011; Weldon letters, June 11, 2012 and July 31, 2014) direct Rio Grande National Forest managers to minimize bighorn and domestic sheep interactions. These letters outline procedures for analyzing the risk of contact between the species and emphasize the need to work with partners at State agencies, adjacent Federal agencies, and wildlife officials to determine and reduce risk to wild sheep species as well as the wool growing industry. A variety of methods to determine the risk of contact are currently in use. Every effort is made to reduce the risk of contact while finding additional areas for domestic sheep grazing.

Suitability

Rangelands that are determined to be not capable of supporting grazing on the Forest include areas with:

- Unstable soils,
- Inherently low potential for production, including areas of rock, road, water, and other barren areas,
- Additional soil and vegetation characteristics, including loose granitic soils, erosive soils, areas with low vegetation cover, or boggy areas,
- Greater than 40 percent slope, length of slope, and natural barriers, and
- A lack of management improvements, including areas that might otherwise be suitable except for a lack of range improvements (little to no fencing, lack of water within 3 miles, etc.).

Responsible officials can close lands to be grazed through several means. Lands that have been formally closed are not considered suitable for grazing.

The 2012 Planning Rule requires that forest plans identify suitability of lands (36 CFR 219. 7(e)(l)(v)). The 31 percent of the Forest lands identified in the 2002 amendment of the forest plan continue to be considered suitable for grazing. Lands determined as not suitable for grazing have been administratively closed to grazing. These include administrative sites, fenced recreation areas, fenced highway right-of-ways, designated management areas or parts of management areas, watersheds, areas within city limits, research facilities and study areas, special-use sites, and critical habitat for threatened and endangered species.

Other areas across the Forest have been closed to grazing for biological reasons, on either a temporary or permanent basis. Biological reasons for closure include riparian areas, developed springs, fens and bogs, and regeneration sites for timber. These areas generally fence livestock out of the area temporarily or permanently.

Livestock producers, as well as outfitters, guides, and visitors depend on forest rangelands to provide forage for stock and recreation opportunities. These same lands provide forage and habitat for a variety of wildlife species.

Affected Environment, Existing Conditions, and Trends

Topography and elevation contribute to the fragmentation of rangelands on the Forest. Lower-elevation rangelands tend to be a mixture of blue grama grass, western wheat grass, needle-and-thread grass, pinyon-juniper, and ponderosa pine. Mid- to high-elevation rangelands tend to be a mixture of Arizona fescue, Thurber fescue, mountain muhly, Parry’s oatgrass, bromegrass, aspen, and spruce-fir. The highest elevations (alpine ranges) tend to be a mixture of intermediate oatgrass, tufted hairgrass, sedges, and krumholtz. Overall, rangelands on the Forest can be characterized by narrow canyons with riparian ecosystems and adjacent grassland communities mixed with timber lands in the montane and subalpine zones.

High elevations and shorter growing seasons make impacts from past grazing practices still visible in places. Sheet and gully erosion is apparent in many areas as a result of these past improper practices on lower-elevation rangelands. Because these areas were most impacted and receive limited annual precipitation, recovery takes more time. Reductions in numbers of livestock and shorter grazing seasons that have been implemented over the last half century are bringing about recovery, if not already fully recovered, in most places.

Range conditions are monitored in key areas on all Forest allotments. The information gathered identifies use patterns, species composition, ground cover, and species frequency. Annual monitoring data show that livestock grazing is ecologically feasible at current levels. Grazing management applies adaptive management principles that allow range managers to modify stocking levels relatively quickly in response to variations in forage production, water availability, and precipitation patterns. These principles have been applied in the past to respond to extended drought conditions and wildfires.

Spruce beetle impacts and mortality to 90 percent of the spruce-fir cover type has allowed sunlight to reach the forest floor, resulting in the understory providing a flush of forage. Initially, the flush of understory forage is providing an attractant to redistribute livestock into these once unsuitable grazing areas. At the same time, access into these areas is also improved. In some cases there may be a short-term loss of a barrier that once was used for livestock management. As time goes by, these areas may still be producing a high level of understory vegetation but trees are beginning to fall and access through the area by livestock is lessened by the obstacles of fallen trees. In most cases, access to these sites is reduced even more than when it was a live forest. If timber harvest activities are implemented in these spruce-fir sites, livestock access and available understory forage may remain high. Reforestation goals also often require that livestock be excluded from an area until trees have become established and reach a size that limits damage from livestock.

Range improvements, including water developments and fences, provide for successful implementation of allotment management plans and annual operating instructions. Forestwide, many of these improvements are in need of updating to increase functionality. Age, weathering, falling trees, and fire have decreased the function of these resources over time, requiring that they be replaced or repaired as funding becomes available.

The amount of available forage, approximately 531,000,000 pounds, has not appreciably changed since analysis for the current forest plan. Approximately 137,000,000 pounds of forage are needed annually to support current grazing levels and wildlife. This leaves an estimated 394,000,000 pounds of forage available for plant health, plant vigor, regrowth, wildlife habitat, soil, and water needs. These estimates vary depending on weather, use patterns, and different species competitions for forage.

The Forest currently permits an estimated 87,456 animal unit months on the Forest; actual use is somewhat less. For the 1996 Final Environmental Impact Statement for the 1996 Revised Land and Resource Management Plan (USDA Forest Service, 1996), Colorado Parks and Wildlife estimated that 70,840 animal unit months of wildlife forage were grazed annually on the Forest. The number of grazing permits is listed in Table 43. The number of capable grazing acres by management area for each alternative is listed in Table 44.

Although forage production is able to support both livestock grazing and wildlife, other conflicts occur. Wildlife and livestock compete for spring and summer forage in certain areas of the Forest. Heavy grazing of riparian habitat by wildlife before livestock are moved onto the allotment can decrease forage availability for livestock, and this can be exacerbated during late snowmelt or drought conditions. Riparian conditions are assessed prior to allowing livestock on the allotments, resulting in changes in the annual operating instructions.

Table 43. Forest grazing permits

		Conejos Peak Ranger District		Divide Ranger District		Saguache Ranger District	
Type	**Status**	**Number**	**Acres**	**Number**	**Acres**	**Number**	**Acres**
Cattle and Horse	Active	17	249,326	25	505,164	20	425,450
	Vacant	1	1,266	0	0	1	8,532
	Closed	0	0	1	9,635	0	0
Sheep and Goat	Active	12	46,449	10	94,537		
	Vacant	14	55,949	5	72,811		
	Closed	0	0	0	0		

Table 44. Capable acres for cattle and sheep grazing, by management area

[Management areas not included in all alternatives shown in parentheses.]

Management Area	Alternative A		Alternative B		Alternative C		Alternative D	
	Cattle	Sheep	Cattle	Sheep	Cattle	Sheep	Cattle	Sheep
1.0 – Wilderness (C)					61,511	9,490		
1.1– Wilderness (B and D)			64,926	11,144			64,926	11,144
1.11- Wilderness Pristine	16,084	4,741						
1.12-Wilderness - Primitive	41,930	5,525						
1.13- Wilderness – Semiprimitive	6,831	862						
1.5-Designated and Eligible Wild River (A)	1,071	128						
1.1a-Recommended Wilderness	0	0	6,500	1,312			60,179	9,145
2.2-Research Natural Area[1]	2	0	2	0			346	28
3.0-Roadless (C)					114,069	21,001		
3.1-Special Interest	13,800	560	5,759	103	0	332	58,230	1,644
3.3-Backcountry	109,636	18,017					6,511	677
3.4-Designated and eligible (A) Scenic River; (B and C) WSR	2,552	265	7,084	1,170			7,514	2,246
3.5-Roadless	0	0	37,507	7,677			21,090	5,341
3.6-Upper Tier Roadless	0	0	75,834	12,624			23,630	5,909
4.1-Special Interest Areas (C)					9,369			
4.2-Research Natural Areas (C)					65			
4.21-Scenic Byway and Railroad	12,981	865	12,909	850	12,922	850	11,884	825
4.23-Congressionally Designated Trail (D)							17,332	776
4.3-Dispersed and Developed Recreation	28,411	4,292	31,853	3,966			20,606	3,205
4.34-Eligible Wild, Scenic River (C)					10,885	3,221		
4.4-Eligible Recreational River (A)	3,556	1,643						
4.8-Ski-based Recreation (C)					7			
5.0-General Forest and Rangelands (C)					279,459	15,012		
5.11-General Forest and Intermingled Rangelands	55,346	2,034	43,594	1,749			36,820	1,494
5.13-Forest Products	40,262	3,018	37,369	2,202			31,174	2,187
5.41-Deer and Elk Winter Range	90,986	4,057	130,710	6,444			115,046	5,809
5.42-Bighorn Sheep (A)	24,734	3,134						

Management Area	Alternative A		Alternative B		Alternative C		Alternative D	
	Cattle	Sheep	Cattle	Sheep	Cattle	Sheep	Cattle	Sheep
6.6-Grassland Resource Production	40,773	789	34,234	335			12,993	152
8.22-Ski-based Recreation[1]	15	0	7				4	0

[1] Research natural areas and ski-based recreation management areas restricted grazing. Portions of the Hot Creek Research Natural Area on the Conejos Peak Ranger District do allow grazing under stipulations.

Effects on Grazing from Vegetation Management

Effects on grazing from timber management would be evident in the increase in forage as trees are harvested, and how protection of regeneration is addressed due to management. As spruce-fir stands die, forage grows up under the dead canopy. These transitory range lands can allow for more dispersal of cattle as more forage becomes available. It also can allow cattle to move between allotments that were previously blocked by timber stands.

All of the action alternatives (B, C, and D) increase the amount of acres identified as suitable timber acres in relation to alternative A, which represents current practices and the current timber suitability being used. Not all acres identified as suitable would be harvested, but the potential to harvest increased in alternatives B and C. Regeneration is an important part of timber management, and grazing within regenerating stands is generally limited or prohibited until trees have grown to a size at which cattle impacts are minimal. Under alternatives B and C, protection of regeneration would potentially limit potential grazing acres. Increased budget for fencing and other infrastructure costs would need to be realized as timber is cleared and areas of regeneration are protected. This is true of all alternatives, but especially for B and C. Alternative D would limit harvest the most and would allow more of the transitory acres to be used the longest and most effectively. Less regeneration fencing or protections would be needed.

Current conditions of dead and dying spruce and harvest activities would create similar issues in cost, scale, and scope in all alternatives, with slight increases in transitory grazing in all alternatives.

Effects on Grazing from Recreation Management

Dispersed recreation use in all alternatives is expected to increase. Increased use would result in more visibility for the grazing program and the potential for increases in conflicts between visitors, livestock, herders, and livestock protection dogs. Because established recreation sites are generally fenced, there is less of an impact to these sites from grazing.

Increased visitor use could also result in vandalism to range improvements and increased management costs and time. Not all members of the visiting public understand the need for gates to keep livestock from wandering into areas where they should not be. Range managers respond to many calls regarding livestock in the wrong place due to gates being left open. This increased need for a response, as well as anticipated increases in maintenance, are costly. These conflicts would continue and increase regardless of alternative, thus there is no significant difference among alternatives.

Effects on Grazing from Designation of Wilderness

Alternatives B and D include areas of recommended wilderness that could be moved forward to Congress, while alternatives A and C have no new acreage of recommended wilderness.

Livestock grazing is an allowable use in designated wilderness as long as it occurred prior to designation (per the Wilderness Act of 1964); therefore, the anticipated acres available for livestock grazing would not change on the basis of wilderness characteristics.

Livestock grazing can conflict with the values of individuals looking for a true wilderness experience. Increasing wilderness would increase costs associated with management to the Forest and to individual permittees through management of grazing itself and increased infrastructure building and maintenance costs associated with restrictions imposed by wilderness designations. These costs would increase proportionally with the increase in acres.

In terms of resource protection there is little difference among alternatives. Grazing would continue as it presently does with few changes.

Effects on Grazing from Designation of Wild, Scenic, and Recreational Rivers

Grazing livestock is permitted in eligible and suitable wild, scenic, and recreational river corridors. Livestock in these areas are managed for the landscape to retain a natural appearance. Riparian pastures and adjacent uplands may require additional management to reduce visual impacts from livestock grazing. Limiting impacts to these areas typically requires additional structural improvements, which would increase the cost of managing livestock in these areas.

Alternatives B, C, and D all incorporate Deadman Creek, which is on the Sangre de Cristo side of the Forest, into a scenic river designation. There is no difference among alternatives because no grazing occurs in this area.

Cumulative Effects

Grazing has occurred on the lands that are now National Forest System lands since before the Forest existed. Past grazing practices strongly impacted current conditions and practices. Reduced numbers of cattle grazed as well as fewer days grazing have helped environmental conditions to recover or greatly improve.

Livestock grazing is impacted by environmental conditions, management practices, and public use for recreation. The Forest supports and manages many different activities. Recreation management, fire management, habitat management, and timber management can affect where and when grazing can occur. Grazing within transitory range (the area of dead spruce) is expected to increase in the next few years. These acres are likely to provide significant increases in forage in the short term. As revegetation activities take place, these acres are likely to be temporarily removed from grazing to protect regeneration. In general, forage and acres would increase fairly significantly over the next few years as the overstory of spruce dies. After this increase, a slow decrease in these acres and forage production would occur until closed canopy of spruce-fir stands occurs many years into the future. This decrease would be accelerated as areas are protected for regeneration and access is decreased from the fallen trees.

Livestock and livestock management activities on the Forest can introduce nonnative invasive species and noxious weed species. An active weed management program exists on the Forest and would continue with cooperation from other Federal agencies, and counties.

Adaptive management of allotments allows range managers to adjust to these changing management conditions. Adjustments would be necessary to maintain healthy range conditions. Effects of actual domestic livestock grazing would be analyzed at the project level and would also include analysis of cumulative effects on a site-specific level. At the program management level, the direct and indirect effects of other similar programs, in and adjacent to the Rio Grande National Forest, when combined with grazing management, would not result in significant effects.

Aquatic and Terrestrial Nonnative Invasive Species (Plant and Animal)/Noxious Weeds

Invasive aquatic and terrestrial plants are defined by Executive Order 13112 as those plants that are not native to the ecosystem being considered, and those whose introduction causes, or is likely to cause, economic or environmental harm or harm to human health. Nonnative invasive plant species include exotic plants and noxious weeds. The Colorado Noxious Weed Act defines a noxious weed as an alien plant, or parts of an alien plant, that aggressively invades or is detrimental to crops or native plant communities; is poisonous to livestock; is a carrier of detrimental insects, diseases, or parasites; and is detrimental to the environmentally sound management of natural or agricultural ecosystems. The State of Colorado designates noxious weeds based on the desire to eradicate or control a particular species within the state (Colorado Department of Agriculture 2017).

Nonnative invasive species generally adapt to habitats where they are not native. Because they lack the natural controls they evolved with in their native range, they tend to rapidly spread, thereby reducing habitat for native species. This decreases ecosystem diversity and generally disrupts the native processes in the environment.

Impacts from nonnative invasive species can occur Forestwide. Many of these species thrive on disturbances caused by activities including timber harvest, road maintenance and construction, trail maintenance and construction, grazing and construction of range improvements, recreational livestock use, and recreational equipment use. Fluctuations in weather events, conditions, and patterns can also spread these species and increase the likelihood of a loss to native habitats. Likewise, changes to current temperature regimes, warmer temperatures, drier conditions, earlier snowmelt and more frequent drought patterns can increase the ability of nonnative species to out-compete native plants in the future.

The Forest has an active program to treat both aquatic and terrestrial nonnative invasive plants. Partnerships and agreements with other agencies and local counties is increasing the ability of the program to increase the amount of acreage treated annually.

Aquatic Plants and Animals

Nonnative invasive species are a serious threat to all aquatic habitats in the United States. Zebra and quagga mussels are a threat to water quality and aquatic lifeforms. Fortunately, these mussels have not as of yet been found in the Forest, with the nearest positive result found in Pueblo Reservoir State Park in the Arkansas River drainage to the east. Within the Rio Grande drainage and San Luis Valley but just outside the Forest, at Sanchez Reservoir State Wildlife Area in Costilla County, rusty crayfish have been positively identified with an order to prevent the transport of any live crayfish from the reservoir (Colorado Parks and Wildlife 2017). Check stations for all watercraft have been established at key locations within Colorado, along with public education initiatives to prevent the spread of invasive species.

When a new aquatic invasive species invasion occurs in a locality, it generally requires research and observation time before reliable inferences can be made regarding spread patterns, specific effects, and potential containment strategies. A baseline typically is lacking to predict how an invasive species from another region or continent will respond when introduced into a new environment. Because a local environment contains a unique assemblage of thousands of interconnected components and processes, the results in one area can vary slightly or significantly from previously infected areas.

If an aquatic invasive species becomes established, eradication may be nearly impossible and efforts for containment can be difficult, time consuming, and expensive. Thus, prevention of invasions is of paramount importance in land and natural resource management. This involves recognizing the vectors for infection and spread and implementing safeguards, or resource protection measures, to minimize and prevent the transmission of invasive organisms through these pathways. An example of a transmission vector would be pumps and other fire equipment that come into contact with water. This equipment is increasingly used and transported globally between projects. Microbes, spores, planktonic larval and adult stages, and plant materials can easily be spread on this and other equipment. Requiring effective sanitation and inspection measures would be appropriate resource protection procedures.

The updated use of fire management zones and the plan components related to these and riparian management zones provide similar protections for aquatic ecosystems among all action alternatives (B, C, and D). Specifically, the use of guidelines and best management practices put forward in the *Guide to Preventing Aquatic Invasive Species Transport by Wildland Fire Operations* provides protection related to the incidental introduction of invasive species (National Wildfire Coordinating Group 2017). Additionally, updates and use of the terrestrial and aquatic aerial fire retardant avoidance maps provides protection under all action alternatives (USDA Forest Service 2017).

Most of the pathways of introduction and spread of aquatic nuisance species are related to human activities, both accidental and intentional. Aquatic invasive species (i.e., zebra and quagga mussels) can be accidentally transported and spread by way of recreational boats and wading boots. Education and outreach will continue to be important to prevent the increased spread of these species, and the Forest Service Rocky Mountain Region continues to support Colorado Parks and Wildlife and other cooperators with set up of key check stations for aquatic invasive species throughout Colorado.

Terrestrial Plants/Noxious Weeds

Direction to use locally adapted seed mixes and limit the use of certified weed-free hay increase Forest defenses against nonnative invasive species. This direction does not change across the alternatives being considered.

Alternatives that propose increased amounts of timber harvest (A, B, and C) and any associated road construction or reconstruction would increase the amount of nonnative species present on the Forest.

Likewise, anticipated increases in recreation use would cause an increased need for inspection for, and treatment of, nonnative invasive species across the Forest. The impacts of nonnative invasive species to water-based recreation include a loss of revenue when areas are closed to boating or swimming due to inaccessibility or for treatment of the water.

Geologic Hazards

An inventory of the abandoned mine lands on the Forest was completed in the 1990s; however, there are new sites documented every year. Some of the abandoned mine sites have significant safety and/or health hazards (e.g., open shafts, emissions of toxic gases, and falling debris). Forest Service staff working with the Abandoned Mine Land Program in the Rocky Mountain Region have been steadily closing these abandoned mines by installing fencing, bat-friendly gates, foam plugs, or back filling. Seven additional sites are planned for closure in 2018. In addition to the safety hazards, many of the sites are a source of environmental contamination. To date, under the authority of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), commonly known as Superfund, the Forest has remediated two mine sites (Summitville and Nelson Tunnel) of environmental hazards. Future abandoned mine lands and CERCLA remediation will be, in part, dependent on financial resources and other Forest Service priorities.

For more information on geologic hazards and abandoned mine lands, see Assessment 10 – Energy, Minerals and Geologic Hazards (USDA Forest Service 2016).

For more information on highly erosive acidic soils and landslides, see the *Soils* section.

Renewable and Non-renewable Energy and Minerals

Overview

Forest Service lands are important storehouses of domestic minerals and renewable and non-renewable energy resources. The search for and production of minerals and energy resources are authorized uses of National Forest System lands, except those lands formally withdrawn from mineral activities by acts of Congress or by Executive authority. Mineral activities on federal lands are facilitated according to the national Mining and Minerals Policy Act of 1970 and are part of the Forest Service mission.

Minerals management is one of the multiple uses of National Forest System lands. Minerals activities are administered through a plan of operations, which includes permits as well as the reclamation and mitigation measures necessary to protect resources.

There are three types of mineral resources. Leasable minerals include oil, natural gas, and geothermal resources, which are made available through lease issuance. Locatable minerals include hard rock resources such as gold, silver, and copper. Salable minerals include rock, gravel, and sand used for construction purposes. Maps of *Oil and Gas Potential – 1995* and *Oil and Gas Lease Parcels – 2008* are contained on the DVD located at the back of this document.

The Forest Service is the surface-management agency and is responsible for protecting surface values during leasable, locatable, and salable mineral activities. For salable minerals, the Forest administers disposal of common variety minerals such as sand and gravel. For leasable and locatable minerals, the Bureau of Land Management manages and makes decisions on the mineral estate and is a cooperating agency with environmental analysis.

Renewable energy developments, such as wind, solar, hydroelectric, woody biomass and other renewable energy sources, currently do not exist within the Forest. The Forest does, however, have potential for these uses. Any proposed renewable energy developments would be evaluated at the project level. More information about existing conditions and trends, is contained in Assessment 10 – Energy, Minerals and Geologic Hazards (USDA Forest Service 2016).

The environmental consequences of the minerals programs by the alternatives are discussed in this section.

Affected Environment, Existing Conditions, and Trends

This section assesses the effects of each alternative on access to and development of energy and mineral resources. The effects of energy and mineral resource development on management of other resources is assessed in those specific resource sections of this environmental impact statement.

It is expected that the current level of use of mineral materials from borrow pits on the Forest would likely continue. Although alternative A estimated up to 23 active wells as reasonably foreseeable tied to the existing active leases at the time of the previous plan revision, all of those leases have since expired. Lease sales proposed in 2008 and 2009 for parcels near South Fork and Del Norte remain deferred as of July 2017. This lack of Bureau of Land Management authorizations for leasable minerals on the Forest will likely continue as it has during the existing forest plan until the current Bureau of Land Management resource management plan and related leasing availability analysis is revised. Thus, the amount of ground disturbance associated with mineral materials and leasable minerals under all alternatives is expected to be on the same order of magnitude as existing ground disturbance from mineral activities only.

Due to locatable mineral activities being more restrictive in neighboring states than they were previously, the Forest has seen an increase in the number of notices of intent and plans of operations. If metal prices rise, this trend will most likely continue. In recent years, the Forest has also seen a significant increase in placer dredging. The Forest requires a notice of intent to be filed and evaluated for any mechanized dredging operation. All operators are provided with information about the best management practices and aquatic considerations.

Interest in exploring renewable energy development on public and private lands, including solar, wind, geothermal, woody biomass, and hydroelectric power at the local, state, and national level, has increased during the past 10 years. Colorado voters authorized a renewable portfolio standard in 2004, which initially required publicly traded utilities such as Xcel Energy to generate at least 15 percent of their electricity from renewable energy sources by 2020. That percentage has since increased and now applies to rural electric associations, including San Luis Valley Rural Electric Cooperative, which serves many communities that border Forest lands. This Colorado Renewable Portfolio Standard, along with Federal direction geared toward energy savings and climate change resiliency, have driven interest in exploring hydroelectric and woody biomass studies directly connected to National Forest System lands, as well as solar and wind studies on the neighboring valley floor, which might require development of additional transmission lines on National Forest System lands. Because the State of Colorado is anticipated to update its renewable energy portfolio within the next 20 years, the Forest needs to consider potential renewable energy projects on National Forest System lands. For more information on renewable energy resources and the history of mining on the Forest, see Assessment 10 – Energy, Minerals and Geographic Hazards (USDA Forest Service 2016).

Direct and Indirect Effects

Impacts to the renewable energy, non-renewable energy, and minerals program resulting from implementation of the alternatives could result in the limitation of some areas to each activity and increased operating costs (through limitations on road construction and use, facility placement, and operational constraints). These impacts may result from the requirements imposed by other resource programs. This estimate of impacts would be considered in conjunction with areas where solid mineral potential is known or suspected to exist, and where preferred locations for renewable and non-renewable energy may be located. Lands may be unavailable for each activity; however, if the resource does not exist on those lands, any possible impacts from limiting access to those lands may be minor or negligible.

Under alternative A, existing laws and formal land withdrawals withdraw some lands such as wilderness, administrative sites, and campgrounds from mining activities. Plan designations and standards and guidelines protect sensitive resources from undue or unnecessary degradation. The existing plan and existing laws and regulations (such as the Endangered Species Act) prohibit or restrict access to and development of energy and mineral resources in some areas in direct and indirect ways. Under the no-action alternative, existing conditions would remain the same. Alternative A also does not contain any plan direction regarding recreational dredging and impacts to fish.

Under alternative B, there would be 58,669 acres of recommended wilderness, which would have an adverse effect on access to and development of renewable energy, non-renewable energy, and minerals, though not at the scale of alternative D. The areas recommended for wilderness, while not withdrawn from mineral extractions, would have restrictions within the area to maintain the wilderness character while operating a mining claim. Renewable energy, such as windfarms and solar arrays, would not be authorized in areas of recommended wilderness, to preserve the wilderness character.

Alternative C would increase the access to minerals and energy resources as a result of a decrease in restricted areas and an increase in timber harvest and related road construction.

Under alternative D, all other renewable energy, non-renewable energy, and minerals projects would be managed under the standard use laws and treated with that level of discretion. In addition, 284,853 acres would be recommended for wilderness inclusion and would be under the same restrictions as alternative B. An estimated 316,085 acres of special interest areas would also provide additional restrictions for mineral withdrawals. Also in alternative D, the Congressionally Designated Trails Management Area recommends withdrawal of the mineral estate within the one-mile-wide trail corridor, which would have additional impacts to minerals access. Alternative D would have the most adverse effect on access to and development of energy and mineral resources due to the greatest amount of use restrictions.

All action alternatives contain plan direction governing recreational dredging and timing to minimize impacts to fisheries. All action alternatives also note updated Federal ownership of the acquired mineral estate in the Chama Basin area. This updated Federal ownership gives the Forest additional discretion regarding future mineral leasing.

Cumulative Effects

In relation to the alternatives, cumulative effects would result from a continuation of the same general restrictions on the minerals program that existed in the previous plan as well as from the imposition of newer environmental laws and regulations.

Within the life of the plan, it is possible that silver mining activity will resume in the Creede area, and the transfer of lands in the Summitville mining district to the State of Colorado will be finalized. It is also possible that oil and gas parcels near Del Norte and South Fork will be nominated for lease again, but those parcels would likely remain deferred until the revision of the resource management plan by the Bureau of Land Management.

Renewable energy, non-renewable energy, and minerals activity is scattered and intermittent in location and timing. The intensity of mineral activities, both in numbers and intensity, is expected to be greater in areas of high mineral potential. Future solid minerals activity outside those specific areas would continue this pattern; as previous activities end, others would begin. The general level of activity would remain the same; therefore, the cumulative impacts on the program and resource from implementation of any of the alternatives on lands with low or no potential for solid minerals may be negligible.

Soils

Overview

Soils are a foundational part of ecosystems and the services they provide. Healthy and productive soils are an essential part of providing ecosystem services such as clean water, forest products such as timber and firewood, and areas for activities such as cattle grazing and recreation. Healthy soils have appropriate vegetation cover in accordance with the capacity of the site and have functioning nutrient cycles without significant nutrient drains. Healthy soils will continue to be an important part of providing ecosystem services and helping to buffer changes to these systems, either human caused or natural changes, from the effects of disturbances including climate change, bark beetle infestations, and wildfire. As these changes occur, soil characteristics and processes are considered so that they can be protected or improved. Maintaining soil health and ecological function is important to all processes on the Forest, and these are safeguarded through regulation and guidance at national, regional, and local levels.

Soil inventory was completed in 1996 (USDA Forest Service 1996). The field work for the soil resource inventory units on the Sangre de Cristo Mountains was completed in the late 1980s but it has never been correlated, so is currently not publicly available through the web soil survey, but information can be obtained at the Forest Service office in Monte Vista, Colorado. These two inventories form the basis for initial soil investigations in relation to activities across the Forest.

Affected Environment, Existing Conditions, and Trends

There are about 115 soil units present across the Forest. Seventy-four soil units are present on the San Juan Mountains side and soils are primarily from volcanic parent material. The remaining soil units are located on the Sangre de Cristo range and the alluvial fans immediately adjacent to them and include units from adjoining soil surveys. Soils in the Sangre de Cristo range were formed primarily from sedimentary rocks and metamorphic derivatives, when Pennsylvanian and Precambrian rocks were uplifted due to thrusting and faulting along the Rio Grande Rift.

In both cases the topography ranges from low, dry foothills just above the valley floor to alpine valleys, often associated with steep alpine glacial cirques. Slopes throughout both mountain ranges can be steep, with elevations ranging from about 8,000 to more than 14,000 feet above sea level, and precipitation ranging from about 10 to 50 inches. Variations in age, slope and parent material, and moisture have led to wide ranges in soils and soil properties. Soils range from very shallow to very deep, with some areas having rapid nutrient cycling and some slow. This varied condition across soils means that the impacts from forest activities will have varied intensities, depending on location and soil present.

Impacts to soils will vary in conjunction with topographical changes, moisture and temperature regimes, and soil characteristics. Unique soil characteristics can occur in limited locations, but generally soils can be viewed as a grouping of similar soils across similar topographical, temperature, moisture, and parent material gradients.

The Forest has a wide diversity of soil types, from minimally developed, nutrient-poor soil to deep, fertile soil. Cool temperatures, a short growing season, and relatively steep topography affect soil development at high elevations. Warmer temperatures, a longer growing season, and flatter topography allow for better soil development at mid- to low elevations.

The expansive, flat part of the San Luis Valley, which contains little to no National Forest System lands, is composed of unconsolidated sediments laid down in the late Tertiary period. Although the San Juan and Sangre de Cristo mountain ranges are the source of these materials, the ranges are of very different origin and geologic age. The majority of the San Juan Mountains are volcanic rocks and related shallow intrusive rocks of the mid- to late Tertiary period. These rocks formed as a result of multiple outpourings of lava and ash from a cluster of volcanos. Recognized as the San Juan Volcanic Field, it is the largest erosional remnant of a continuous volcanic field that once extended over much of the southern Rocky Mountains in Oligocene times. The volcanic sequence involved initial intermediate lavas and breccias followed by more silicic ash flow tuffs, ending with a combination of basalts and rhyolites. This part of the San Juan range consists of rolling foothills in the east to steep alpine slopes along the Continental Divide.

The Sangre de Cristo Mountains are of more recent origin than the San Juan Mountains, but the rocks themselves are considerably older. These mountains consist of a very steep, narrow ridge that formed as a result of faulting and thrusting along the Rio Grande Rift. The mountains are composed of sedimentary rocks of the Pennsylvanian period along with Precambrian granites, gneisses, and schists. Landforms vary from steep alpine glacial cirques to very broad alluvial fans at the mouth of drainages.

Soils in the San Juan range are typical of soils derived from volcanic material. They are generally shallow to moderately deep, medium textured, and low to moderate in nutrient content. Organic matter and nitrogen levels tend to be low because of low rates of decomposition and nitrogen fixation. Shallow, course textured, rocky soils are found on ridgetops and adjacent steep slopes. The southern part of the San Juan range near the New Mexico border consists of volcanic material overlaying shale, so mass movements are common. Some soils in the Alamosa Canyon area are inherently highly erosive. Also in this area are soils where natural rock acidity results in naturally high levels of leaching of heavy metals.

Soils in the Sangre de Cristo range tend to be moderately shallow and are coarse textured. These soils are moderately erodible and infertile due to limited moisture, steepness, and coarse texture.

It is unrealistic to describe soils across the Forest in any meaningful way. In the 1996 forest plan, land type associations were developed based on similarities in geology, soils, and plant associations. A good summary of soil characteristics and geologic characteristics of the area is contained in Assessment 2 (USDA Forest Service 2016). It should be noted that in Assessments 1 and 3 (USDA Forest Service 2016), the land type associations were replaced by combining a few land type associations by ecosystem or vegetation types and adding two ecosystems for modeling purposes, but they generally align with the major plant associations described in the current forest plan land type associations.

The proposed action and need for change analysis did not determine a need for change in relation to soils. Overall monitoring, whether it occurred on a forest plan or project level indicated that overall, soil conditions are improving across the Forest. Areas of concern still exist but they are addressed on a project level and have not become widespread across the Forest so do not represent a need for change at a Forestwide level. The current forest plan was developed about the same time that each region was establishing components of the watershed conservation practices handbook (FSH 2509. 25). The handbook was finalized following the signing of the 1996 forest plan. The standards and guidelines from the plan had become handbook direction, and the Forest has used handbook direction as standards and guidelines since. These have served to protect the soil resource over the life of the plan and will continue to be followed despite not being standards and guidelines in the plan.

Soil protection and improvement are the overriding principles that guide the soil program across the Forest. Forest Service Handbook and Manual direction continue to apply. These layers of protection will continue to guide soil management across the Forest. Forestwide direction provides the Forest an opportunity to direct soil management across the Forest in a multiple-use environment while still protecting the soil resource.

Forest plan guidance contains direction that limits creation of detrimental soil conditions to 15 percent of an activity area. The limit of 15-percent disturbance of any one unit to detrimental soil disturbance is higher-level direction, but the guidance expands the direction to make it specific to the Forest. The 15-percent limit was recently confirmed in a watershed study. Disturbance levels above 15 percent within a watershed were found to have detrimental effects on stream invertebrates (Steuer 2010). Even though this study concerned urbanization, it involves the increased level of impermeable surface. Detrimental soil disturbance generally concerns activities that alter soil physical or chemical properties, which can lead to loss in soil productivity and increases in soil erosion and nutrient loss.

This standard limits the amount of detrimental soil disturbance by regulating activities that can cause these impacts. These impacts are generally one of the following: soil rutting or ponding, compaction, displacement, erosion, or removal of the topsoil or organic matter.

Puddling occurs when infiltration of water into the soil is slowed and puddles are present on the soil surface, or the soil profile is saturated or very wet. This condition can lead to rutting, which is the destruction of soil structure typically caused by equipment. This condition makes indentions into the soil and if wet enough can create deep furrows in the soil. Rutting can also be created by numerous passes over the same area. Activities are typically suspended when rutting occurs until drier conditions are present. Designated skidder trails and rubber tire skidders are also used to prevent rutting. Ruts are very visible and disrupt normal hydrologic flow and surface and subsurface water.

Soil compaction is caused by an increase in soil bulk density and a reduction of porosity. Skid trails and landings are the most likely cause of compaction, which can increase erosion, ponding, or puddling, and slower infiltration. Landings and skid trails are the main source of compaction from timber sales. These areas experience repeated passes by equipment. Williams and Nielson (2000) determined that the majority of impacts typically occur within the first few passes of the equipment. Any activity can cause some degree of compaction, but it is often related to soil type, rock content, and soil moisture status. Compaction can reduce productivity by limiting root growth, and soil infiltration and movement, in the soil. These changes can also limit nutrient transfer and impede air movement into the soil. Soil compaction can lead to slower water infiltration and increased runoff and erosion, and also increases the incidence of puddling and rutting.

Soil hydrophobicity is created when soils are heated to the extent that chemical and physical properties are altered in the soil. This creates a soil that does not easily absorb water and therefore increases runoff and erosion. It also is susceptible to wind erosion and nutrients are volatilized, thereby creating a soil that is dry and infertile. This can occur during large wildfires, but also occurs in pile burning. Impacts from soil heating increase as temperature increases, from mortality of seeds and microbes (about 60 degrees Celsius), to development of hydrophobicity (175 degrees Celsius), to loss of nutrients, organic matter, and structural degradation (greater than 200 degrees Celsius) (Stoof 2013). Small and light burns do not create hydrophobic soils. Typically it is the residence time of the fire and not the intensity of the fire that creates this issue. Stoof (2013) found that fire residence time was more strongly related to hydrophobicity in soils than fire intensity.

Wildfires are natural events that occur at varying frequencies, depending on ecological characteristics. They can be small or very large. They generally burn in a patchwork of intensities, with the soils in some areas being severely affected while others only slightly affected. The heterogeneous nature of an area allows for a variety of soil burn severities to occur in one location. Prescribed burns are planned and accomplished in a way to limit severely burned areas. Effects of prescribed fires are similar to those of wildfire but occur over smaller areas and in planned areas that are calculated for overall benefit of the ecosystem. Pile burning often has the most severe impacts over the area that they are conducted. Typically they will have some amount of severely impacted soils; however, each pile is small in relation to harvest units and analysis areas. They are rarely of significant size and as a result, the overall impact is small.

Not all soils and situations are conducive for fire introduction. Very steep slopes, highly erosive soils, or soils prone to mass movement may have negative responses to fire effects, and in some cases these responses may be dramatic. Managers of planned fires such as prescribed burns must take these situations into consideration. Soils with a potential to be severely damaged by fire need to have specific protections built into the planning, as do situations with steep slopes that are more prone to severe burning impacts. Limitations for prescribed burning for soils can be found in the soil resource and ecological inventory for the Forest (USDA Forest Service 1996).

Soil displacement is the movement of soil material from its original position on the landscape. It is typically small in scale, a few inches to a few yards, or it could be on a large scale such as a landslide. Displacement of topsoil and other material create areas where erosion is accelerated. This process is commonly occurs through mechanical means such as timber harvest equipment turning, skidding of logs, blading of roads, fireline construction, and construction of roads and trails. Along with accelerated erosion, nutrient loss can also be accelerated through this process.

Erosion is a natural process by which soil particles are dislodged and moved. The most common modes of movement are water and wind. Erosion occurs naturally over time. Stream systems and other natural systems generally can accommodate normal levels of erosion. Accelerated erosion is more a condition where some activity or event has occurred that exposes bare ground, creates compaction, or otherwise alters some other soil property that increases erodibility. The amount of soil erosion that occurs depends on a number of factors including amount of bare soil, slope steepness, erodibility of the soil, and rainfall intensity. Erosion is offset by conditions such as the amount of leaf litter, slash, and woody debris present on the landscape. Natural systems are not as well adapted to these conditions. Most erosion on the Forest occurs along roads, in timber sale areas, and in established recreations sites. Proper design, construction, and maintenance of infrastructure can reduce erosion to acceptable levels.

Nutrient cycling is an important part of soil productivity. It is essential that adequate levels of soil organic matter be maintained to protect site and soil productivity over the long term (Jurgensen et al. 1997). Nutrient drains can also be created by removing trees along with limbs, branches, and some needles. Nutrients can also leave the stand when piles are burned through volatilization of carbon and nitrogen and later through erosion of soil from the site. Nutrients in forested stands are cycled through fine woody debris with some contribution of coarse woody debris. Decomposition of fine woody debris, including leaves or pine needles, is the largest and most readily available source of nutrients. Thus it is important to retain fine slash within units, especially if bare soil is present or if the nutrient cycling rate is slow.

Recent articles have questioned the importance of coarse woody debris to this cycling. Laiho and Prescott (2004) estimated that coarse woody debris contributes less than 5 percent of the nitrogen released annually, and concluded that it is of only minor importance to nutrient dynamics. A similar study agreed with the role of coarse woody debris in the short term but concluded that coarse woody debris would be an important nutrient source in the future as well as an important carbon sink (Ganjegunte et al. 2003). It is not clear whether woody debris should be left and in what quantities. Other factors, including wildlife needs, are also factors to consider and have resulted in recommendations of woody debris to be left onsite following management activities. These recommendations will accomplish multiple resource objectives.

Fire can create a nutrient drain on the soil. Soils that are highly impacted by heating generally lose surface organic matter, and much of the soil organic matter is altered or lost altogether. Physical changes also occur. These changes leave soils drier, less fertile, and more subject to erosion by both water and wind. Small and light burns of short duration do not create this effect because intensity and residence time do not create the required soil heating, and thus have less impact than hot, long-burning fires. The majority of nutrients occur in the organic layer and surface layer of the soil; whether removed by mechanical means or by fire, years are required to re-establish similar amounts of soil nutrients.

Road construction and reconstruction generally can be considered in relation to short-term impacts and long-term impacts. Short-term impacts occur when a road is constructed, reconstructed, or maintained. Sedimentation to streams and erosion associated with displaced soil material increases. Proper sizing and placement of culverts, placement of rolling dips, and other erosion control structures do not eliminate erosion completely but help prevent sediment from reaching waterways and greatly reduce the amount of erosion that occurs. Long-term impacts are those impacts that could be considered background levels. These long-term effects remain fairly negligible if roads are well planned, built with proper materials and methods, and properly maintained. If roads are not maintained they can begin to erode and cause increased erosion, this is especially true of poorly placed roads or with stream crossings that are poorly planned or installed. Processes, practices, and concerns hold true for trails, both motorized and nonmotorized. The scale for trails is smaller than for roads but similar otherwise, and management approaches are similar.

Off-road travel by motorized vehicles is generally prohibited on the Forest except under very specific conditions. Off-road travel has the potential to be very damaging to soils. Driving on unhardened areas can cause compaction and rutting and can kill vegetation. These damages can increase erosion, but additionally, can channelize water, which can accelerate erosion, dry out the site, and create gullies. These impacts can be either minimal or very harsh depending on soil properties and current conditions. Very dry rocky soils will show only minimal impacts, while wet non-rocky soils can have very significant impacts. Thus it is important to limit off-road travel.

Limiting detrimental impacts to soil to 15 percent of each project area would protect the soil resource. This standard would also allow for activities to occur that would help to improve conditions across previously disturbed areas.

Including design features and best management practices in addition to forest plan guidance would further protect soils during management activities. Forest Service handbook and manual direction is incorporated into all forest plans and project-level proposals. This combination of direction considers management of the soil in a holistic manner allowing for the restoration of soil function, regardless of cause of the impairment. It also establishes a framework for managers to provide multiple use activities while providing resource protection.

During development of the soil survey or resource inventories (USDA Forest Service 1996) of the San Juan and Sangre de Cristo portions of the Forest, soil potentials or interpretations were developed. These potentials provide low, medium, high or good, fair, or poor ratings for activities on the Forest or soil conditions on the Forest. These potentials will be used in the assessment of the effect of a given activity on the Forest.

Direct and Indirect Effects

Soils connect all activities on the Forest. Most management activities and decisions affect the soil where they occur. The most common impacts are compaction and erosion. Increased compaction will increase runoff and can also increase erosion. Mechanical harvesting, road construction and maintenance, motorized trail use, and off-road all-terrain-vehicle use create the most immediate, visible, and concentrated soil impacts. Grazing can also lead to very visible and sometimes widespread impacts. Most other impacts are less visible and localized. Designations such as, but not limited to, wilderness, roadless, and research natural areas limit activities and effectively increase protections of the soil resource. Opposed to those are activities that increase soil disturbances such as recreation and timber harvest.

These effects are mitigated through the use of best management practices and project design features as directed by forest plan standards and guidelines as well as handbook and manual direction.

Effects on Soils from Timber Harvest

Erosion, displacement, compaction, and changes due to pile burning are the most likely impacts from timber harvest. These soil characteristics are measured as a way to estimate soil processes such as nutrient cycling, soil health, and productivity. Effects on soil will be discussed in terms of these soil characteristics and will focus on mechanized whole-tree harvest activities. They are the most likely activities to create detrimental disturbance, and other methods will be a subset of these conditions so will be covered in this review.

Timber harvest can affect soil productivity through compaction caused by equipment used during harvest operations. Skid trails and landings are the most likely to experience detrimental compaction, which can increase erosion, but can also increase ponding or puddling, which can lead to more compaction, displacement, and slower infiltration. More skid trails mean more compaction. The biggest impact from timber harvest is generally compaction. Landings and skid trails are the main source of compaction. These areas experience repeated passes by equipment. Williams and Nielson (2000) found that the majority of impacts typically occur within the first few passes of the equipment. Limiting the number of landings and the amount and length of skid trails becomes the most effective way to limit soil compaction.

Soil erosion can also be an impact of timber harvest activities. The amount of soil erosion that occurs depends on a number of factors including amount of bare soil, slope steepness, erodibility of the soil, and rainfall intensity. It is offset by factors including leaf litter, slash, and woody debris left on the landscape. As bare soil increases, soil erosion potential increases. Leaf litter and other debris serve to protect soil from raindrop impact and form physical barriers to stop soil movement.

Timber suitability will be used to assess differences among alternatives, in relation to erosion potential, mass movement hazard, and reforestation potential. Reforestation potential is not rated on all soils and therefore does not cover the entire Forest, but it will help show differences among alternatives. Because percentages or approximate acre comparisons will be used, they may not add up to 100 percent or match the final acreage in the proposed action.

Alternative A has the lowest portion of timber-suitable soils on high-erosion-potential rated soils at 33 percent, followed by alternative B at 34 percent and, alternatives D and C at 35 percent. Mass movement potential had very little difference among high potentials: alternative A had the highest percentage at 3 percent, with the other alternatives at 2 percent. Low and very low ratings for mass movement for all alternatives added up to 87 percent. Alternative A had the lowest poor rating for reforestation at 8 percent, alternatives B and D at 11 percent, and alternative C at 12 percent. There is very little difference in the percentage of soil ratings by total suitable acres. This doesn't show total acres in each category. Bar charts that represent these erosion, mass movement, and reforestation potentials by total acres impacted are shown in Figure 15, Figure 16, and Figure 17.

Across all alternatives, acres with a low erosion hazard rating are minimal. Those acres of soil that are rated moderate and high show a more pronounced change. With high potential acres there is more than a 50,000-acre difference between alternative A and alternatives B and C. There is about a 35,000-acre difference between alternatives A and D. In respect to erosion potential, alternative A is the least impactful.

Alternatives B and C are not in practice different, as they are similar in amount of acres rated as high for soil erosion potential. Alternative D is somewhere in the middle.

It should not be assumed that soils will erode because the rating for the potential is high. Best management practices and careful planning can mitigate this potential danger. The potential is still there and current management, alternative A, is potentially the least impactful to the soil resource in respect to erosion, with alternative C being the most impactful.

Mass movement potential, shown in Figure 16, shows that very few acres are included within the rating of high. This is generally what is expected as most areas that are high in mass movement potential do not have many trees, and therefore are not rated as suitable timber base. Acres of high mass movement potential are associated with the Cumbres Pass area, which has high mass movement potential rated soils, but due to local conditions like low slopes, are considered lower risk. Some acres can likely be attributed to mapping errors. Alternatives A, B, and C are separated by less than 1,000 acres, and alternative D by less than 4,000 acres. Alternative D is the most protective of the soil resource, but there is not a significant difference among the alternatives with respect to mass movement.

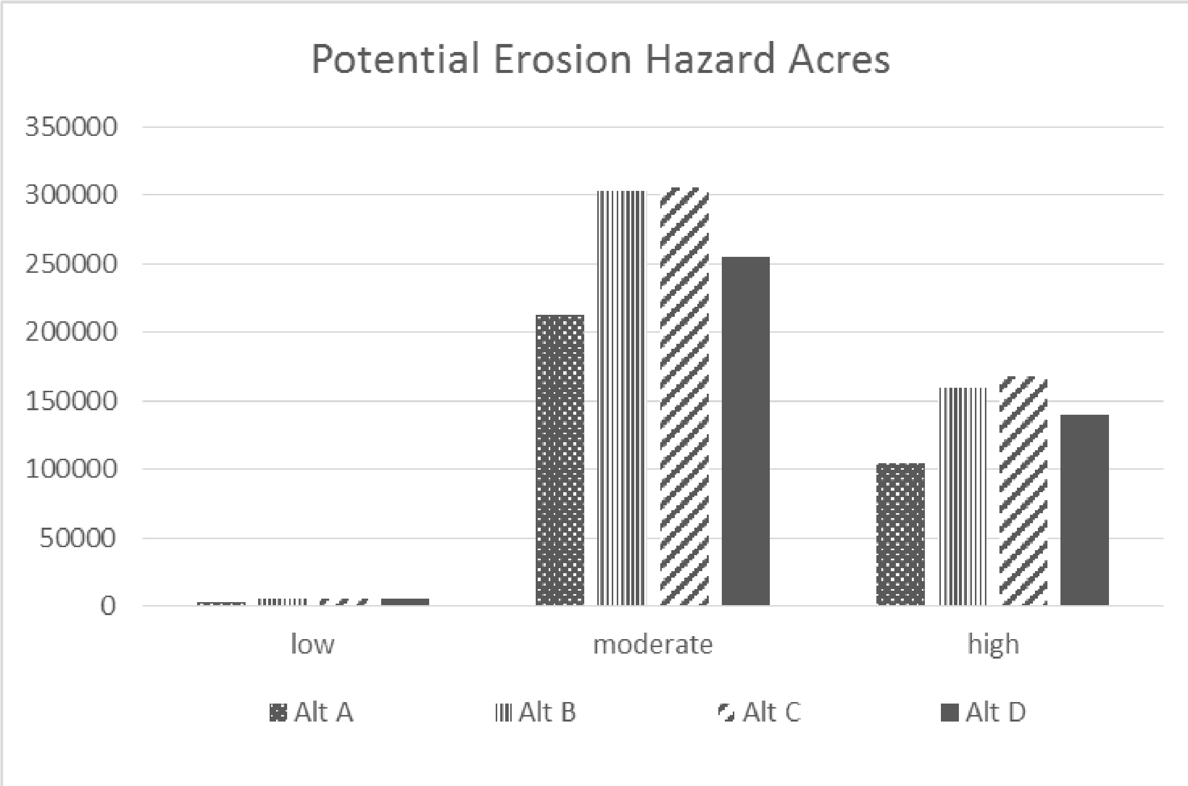


Figure 15. Potential erosion hazard acres by alternative

Reforestation potential (Figure 17) shows that alternative A includes the fewest acres with poor ratings for reforestation on about 25,000 acres, while alternative C has the most with approximately 52,000 acres. Alternatives B and D have about 47,000 and 42,000 acres, respectively. The number of acres for good and fair ratings is larger but follows the same pattern as that of the poorly rated soils, with alternative A having the least acres and with alternative C having the most. Alternative C is the least restrictive and therefore can be the most impactful.

Changing climatic conditions and natural drivers, such as bark beetle infestations, will be present and continue to influence the impacts of timber management activities across the Forest. Soil interpretations help in the planning process to protect sensitive soils from activities that may harm them. Alternatives A and D are the most protective of the soil resource as a whole in relation to timber management, while alternative C seems to be the least, though it is not significantly different than alternative B in acreage impacted.

Reforestation is an important aspect of forest planning, as most of the spruce-fir forest was affected by the spruce beetle. Dead trees change the soil-water dynamic. Soils that dry out due to more sun exposure or increased evapotranspiration due to increased undergrowth make it harder to reforest an area; conversely, wetter soils due to loss of uptake by trees makes more soil water available and can enhance or inhibit reforestation, depending on species.

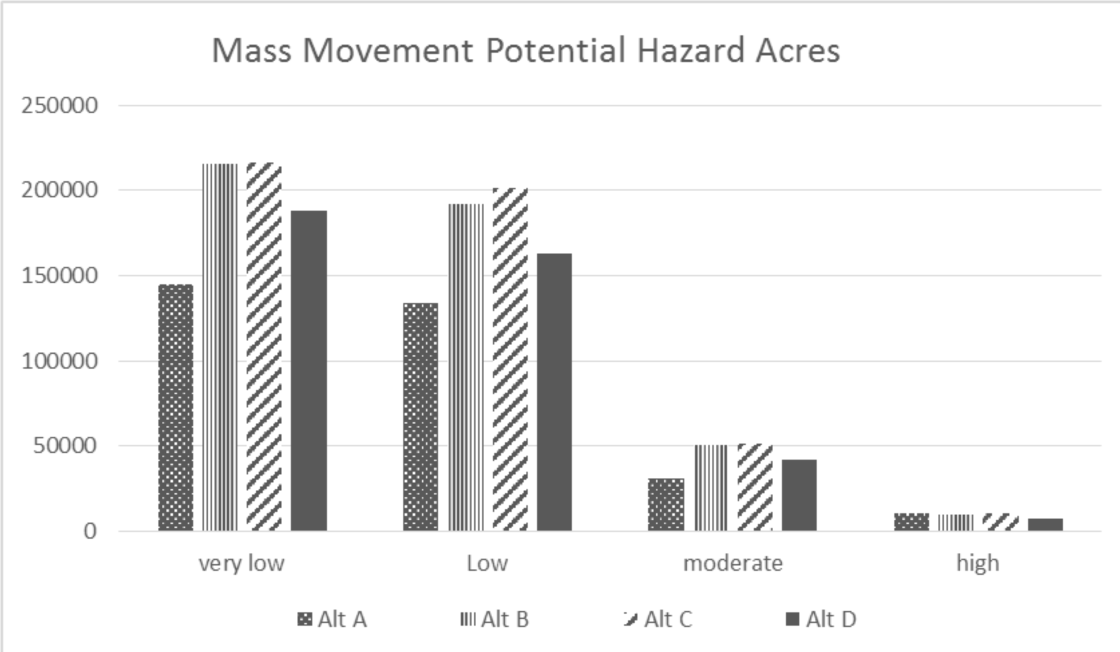


Figure 16. Mass movement potential hazard acres by alternative

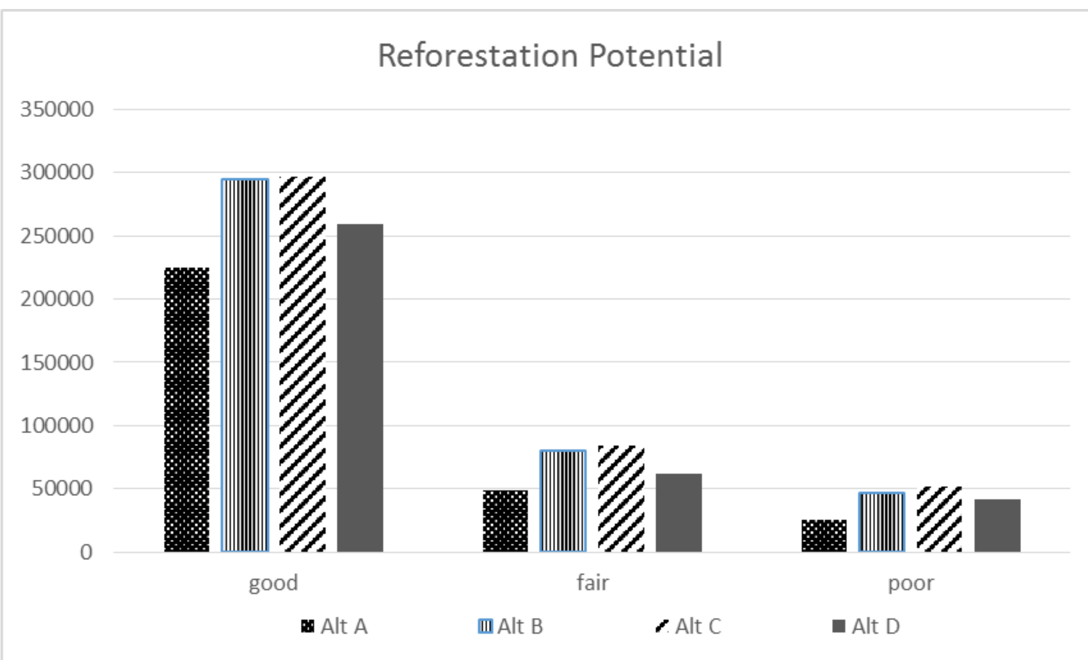


Figure 17. Reforestation potential by alternative

Changing climatic conditions and natural drivers, such as bark beetle infestations, will be present and continue to influence the impacts of timber management activities across the Forest. Soil interpretations help in the planning process to protect sensitive soils from activities that may harm them. Alternatives A and D are the most protective of the soil resource as a whole in relation to timber management, while alternative C seems to be the least, though it is not significantly different than alternative B in acreage impacted.

Planned vegetation management activities have different results than suitability acres. Planned management activities are estimated using expected budgets, targets, and workforce capacity. According to planned activities, alternative D has the fewest average planned acres harvested per year, while alternative C has the most. Alternatives A and B vary only slightly in average acres per year to be harvested. Similar to suitability acres, alternative C is the least restrictive and will have the most potential for soil impacts. Alternatives A and B have equal opportunities to impact soil resources, with alternative D having the least potential to impact due to having the lowest number of projected acres to be harvested.

Overall, alternative A has the fewest amount of acreage to potentially be impacted; however, practically, alternative D has the fewest planned acres and will likely have the least impact to soil resources over the life of the plan, with alternatives A and B having similar impacts, being only slightly more than D (about 1,000 acres more each year), and D being the most impactful with about 3,000 more acres each year.

Effects on Soils from Fire Management

Soils can be impacted through fire management activities. These impacts are associated with soil heating, which can cause a number of physical and chemical changes within soils, including hydrophobicity, erosion, and nutrient loss.

Wildfires occur at varying frequencies depending on different ecological characteristics. They can be small or very large. They generally burn in a patchwork of intensities, with the soils in some areas being severely affected while others are only slightly affected. While some areas are severely impacted, the heterogeneous nature of the areas in which they impact also allows for a variety of impacts. As a result, localized areas of concern are generally identified; the heterogeneity of the area helps mitigate any severely burned areas with areas of slight to no burn. Prescribed burns are planned and accomplished to limit severely burned areas. Effects are similar to a wildfire effects but occur over smaller areas and in planned areas, which are calculated for overall benefit of the ecosystem. Pile burning typically has the most severe impacts where they take place. Typically they will result in some amount of severely impacted soils; however, each pile is small in relation to harvest units and analysis areas. They are rarely of significant size and as a result, the overall impact is small.

Not all soils and situations are conducive to fire. Very steep slopes, highly erosive soils, or those prone to mass movement may have negative responses to fire effects, and in some cases these responses may be very dramatic. Planned fires such as prescribed burns must take these situations into consideration. Soils with a potential to be severely damaged by fire need to have specific protections built into the planning, as do situations with steep slopes that are more prone to severe burning impacts. Limitations for prescribed burning for soils are contained in the soil resource and ecological inventory (USDA Natural Resources Conservation Service 1996).

It is not anticipated that the soil resource will be impacted differently among alternatives. Alternatives B, C, and D allow for more use of fire for resource benefit than is possible under the current forest plan (alternative A), allowing for more fire use across the landscape. Prescribed fire is generally employed to improve habitat in mixed conifer stands, including pinyon-juniper stands, and grass dominated areas. These areas typically do not have fuel to encourage long residence time of fire across large areas. Some soils will be detrimentally impacted by fire, but it will be spatially separated so will not exceed allowable limits. Alternatives B and D will also limit some areas where fire may be ignited as more wilderness may be added in these alternatives.

Effects on Soils from Livestock Grazing

When grazing is managed properly, livestock are well distributed, and grasses are grazed only to specified limits to leave adequate grasses for wildlife needs and soil protection and to promote soil fertility and productivity. When grazing is not managed properly, uplands and riparian areas can be compacted and increased erosion and bare soil can occur, associated with a reduction in vegetation cover and reduced soil health and productivity.

Strategies for improving soil conditions on rangeland include reducing numbers of animals on the landscape, resting range in poor condition, and herding of cattle for better distribution across the landscape. Though this is not an exhaustive list, strategies are used together in an adaptive way to improve overall range condition and to promote and maintain soil health and productivity.

Very little change will occur to grazing acres among alternatives. Alternative A has approximately 540,310 acres as capable of supporting grazing. The other three alternatives list capable acres of 539,935 acres. Because this small adjustment of acres will have no discernible impact on the soil resource from grazing activities among alternatives, there is no difference among alternatives in relation to livestock grazing.

Effects on Soils from Roads and Trails

Road construction and reconstruction generally can be considered as short-term impacts and long-term impacts. Short-term impacts occur when a road is constructed, reconstructed, or maintained. Sedimentation to streams and erosion associated with displaced soil material increases. If proper best management practices are adhered to, minimal amounts of erosion occurs, which diminishes over the long term. Proper sizing and placement of culverts, placement of rolling dips, and other erosion control structures do not eliminate erosion completely but will prevent sediment from reaching waterways and greatly reduce the amount of erosion that occurs. Long-term impacts are those impacts that could be considered background levels. These long-term effects remain fairly negligible if roads are well planned, built with proper materials and methods, and properly maintained. If roads are not maintained they can begin to erode and cause increase erosion, this especially true of poorly placed roads or with stream crossings that are poorly planned or installed. Processes, practices, and concerns hold true for trails both motorized and nonmotorized. The scale is smaller roads but similar otherwise and management approaches are similar.

Off-road travel by motorized vehicles is generally prohibited on the Forest except under very specific conditions. Off-road travel has the potential to be very damaging to soils. Driving on unhardened areas can cause compaction and rutting and can kill vegetation. These damages can increase erosion, but can additionally channelize water, which can accelerate erosion, dry out the site, and create gullies. These impacts can be either minimal or very harsh depending on soil properties and current conditions. Very dry rocky soils will show only minimal impacts while wet non-rocky soils can have very significant impacts. Thus it is important to limit off-road travel.

Roads and trails across the Forest are expected to remain the same or decrease across the Forest over time due to travel management. Only significant changes in roadless areas or wilderness areas would impact soils in relation to these in a meaningful way. Adjusting large sections of these boundaries to either allow or remove roads and motorized trails from areas would potentially impact soils and waterways by increasing erosion due to construction or lack of maintenance from road closures. Both sides of that process could potentially negatively impact soils. If roadless or wilderness areas are increased and roads and trails are properly and thoroughly closed, then beneficial impacts could be expected. Alternatives B and D analyze for more wilderness, research natural areas, special interest areas, and wild, scenic, and recreational rivers. All these have the potential to decrease roaded areas, thus decreasing the roads on the system and road impacts. In practice they will not impact the amount of roads on the Forest in a meaningful way; therefore, there is not a measureable difference among alternatives in relation to soils.

Effects on Soils from Recreation

The effects of recreation on soils are expected to be small. Activities such as camping, hiking, mountain bike riding, all-terrain-vehicle trail riding, picnicking, sightseeing, and other similar activities have very small localized impacts due to compaction and erosion. Over time established recreation sites will show more pronounced impacts, but they would still be localized. Game retrieval using all-terrain vehicles is also likely to impact soils in a significant way. Most impacts associated with recreation activities are associated with roads and trails.

For information on roads and trails see the *Infrastructure, Roads, and Facilities* and *Sustainable Recreation Opportunities* sections.

Alternative A would continue current practices, which would have limited impacts spatially. Local impacts may be considerable, but are generally small in scale. This trend in soil disturbance will continue regardless of alternative. Alternatives A and B have a management area designated for recreation, Management Area 4.3. Alternatives C and D do not designate a management area specifically for recreation. Alternative C gathers all forest management acreage under one geographic area called general forest and rangelands. Alternative D spreads the acreage across four management areas and has increases in special interest and wilderness areas. In addition, alternative D would eliminate off-road game retrieval. This would help to eliminate off road all-terrain-vehicle travel in general and would provide increased protection to the soil resource.

Soil protection measures established through standards and guidelines, and regional and national direction, will apply regardless of alternative; thus, it is anticipated that in respect to the soil resource, little difference is expected among alternatives. Dispersed recreation will continue to occur across the Forest regardless of designation, and developed recreation sites will continue and have plans of operation. Little will change in regard to soils under any of these alternatives.

Effects on Soils from Designation of Wilderness, Recommended Wilderness, Research Natural Areas, Special Interest Areas, Scenic Trails and Byways, and Wild, Scenic, and Recreational Rivers

Impacts to soil from one of these designations is likely minimal along public access areas and a positive impact across the rest of the area. Designated areas generally are more restrictive to activities and therefore are less impactful to resources than other areas. No significant impacts are expected from the inclusion of these designated area.

Alternatives B and D would increase the acreage to be analyzed as wilderness, special interest areas, eligible and suitable wild, scenic, and recreational rivers, and research natural areas. Designation of new wilderness and research natural areas would be beneficial to soil function, productivity, and health. Because they are very restrictive in allowed activities, soils function in a natural manner. Nutrient cycling occurs at a natural rate, with inputs and exports of nutrients occurring as dictated by natural conditions. This is a desirable condition and allows for healthy and productive soil as well as good reference soil points.

No difference between geographic areas and management areas is expected, because the acres offset very little and because standards, guidelines, and regional and national direction do not change by alternative. Because alternatives B and D have increased amounts of designated areas, they are considered more protective of the soil environment than alternatives A and C.

Effects on Soils from Mineral Resource Activities

In the current forest plan it was estimated that soil disturbances from mineral activities would be 69 to 216 acres over the next decade, or 7 to 22 acres per year. Similar numbers are expected over the life of this plan.

Mineral activity impacts on the soil resource would be mitigated through standard lease terms, stipulations, operating plans, and permits. These restrictions would be guided by standard best management practices and regional and national guidance. Impact levels are expected to be small, spatially separated, and within acceptable levels by following established procedures and guidelines.

No difference among alternatives is identified in relation to mineral extraction and soils. Mineral extraction is heavily dictated by laws and regulations that dictate how it will be addressed. The differences in alternatives will not impact this situation.

Cumulative Effects

Soil productivity would be mainly impacted by surface disturbance and vegetation loss associated with activities that produce these types of conditions. The cumulative results expected are increasing soil erosion and loss, and potential compaction. Landslides are also of concern as some have occurred in the past, and some areas are more susceptible to landslides than others.

Past timber harvest areas are still recovering in some locations but are generally slow to recover. Because current harvest practices and technology have improved over what was used in the middle of the 20^{th} century, the impact to the soil surface is less. Impacts from current timber harvests are limited by the implementation of best management practices and other direction. One of these practices is to limit detrimental soil disturbance per unit to 15 percent. Repeated entry to units could push units currently under 15 percent over that limit. As the salvage harvest of dead spruce declines as merchantability declines, less impact to units will occur and these areas will have a long time period to recover as the spruce forest grows back. Harvest activities within other cover types may increase, but because these areas do not include as many acres as the spruce-fir cover type, the overall impact to the Forest over time will decrease.

Roads and other transportation infrastructure have been built and maintained at some level for many years. Most National Forest System roads have been in service for many decades. Erosion from roads is one of the biggest contributors to sedimentation from soils to streams. Well maintained roads and stream crossings help prevent this erosion. Poorly maintained and designed roads can lead to significant amounts of erosion. Budget cuts have led to longer intervals in between road maintenance cycles, which increases erosion. Travel management discussions following plan completion could recommend roads to close. If roads are closed it could lead to shorter maintenance cycles and to less erosion in the future. Otherwise the future conditions will be similar to what they currently are.

Fire, grazing, and recreation all cause effects to soils. Fire is a naturally occurring event. It has occurred in the past and will continue to occur in the future. Frequency and intensity could be impacted related to a changing climate. Drier conditions could lead to more frequent fires and wetter conditions to fewer fires. Changes in precipitation type would change the entire dynamic of the fire cycle as it currently is. Fire management currently attempts to average 2,000 acres of prescribed burns each year, and that is anticipated to continue into the foreseeable future. Grazing has occurred for more than 100 years. Recent changes in grazing practices and numbers have led to marked improvement from the early 1900s. Soils are improving under current grazing management practices, and it is anticipated that they will continue to do so. Possible continued drought conditions would lead to additional changes to maintain grazing at acceptable levels. If these are not observed, however, soils could be detrimentally impacted and could return to conditions similar to those of the early 1900s. Recreation is anticipated to change very little from the past to the future. Trailer camping could increase as more and more people from population centers spend time in the mountains. Recreation impacts will continue to be localized, even in the face of continuing drought conditions, and will be managed on a local level to protect resource values.

The designation of wilderness areas and other specially designated areas will have an impact on the resource. Past designations of protected areas have helped to protect the soil from possible impacts of management activities. They will continue to do so into the future. They will also serve as an area to look at changes to soil and the surrounding environment as environmental drivers push on the systems as climatic changes occur or as the forest recovers. From a soils perspective, a wilderness designation is not different than a roadless area or research natural area designation. Areas outside these already designated areas will benefit from inclusion, but changing one to another will not impact the soil resource.

Aquatic Ecosystems

Overview

This section considers numerous physical and biological resources such as water quality, native species, and aquatic habitats. Managing for high quality water and hydrologic function is fundamental in maintaining and restoring watershed health.

Riparian and aquatic systems, as water sources, are ideal for many land uses managed by the Forest Service. Conflicts between some human uses, however, and the resources dependent on resilient riparian conditions may continue unless management provides for sufficient land use limitations and resource protections that maintain the disturbance processes and pathways associated with resilient riparian conditions (Reeves et al. 1995; Lee et al. 1997; Lake 2000; Poff et al. 2011, Pyne and Poff 2016). Forest plan direction is intended to minimize, if not resolve, these conflicts.

Aquatic species viability is dependent upon maintaining an array of well-connected habitat conditions. Management activities can contribute to fragmentation and degradation of habitat for fish and other riparian-dependent species. Dam construction, introduction of nonnative invasive species, livestock grazing, road and facility construction, and timber management activities have resulted in major changes in habitat conditions. Future management activities have the potential for both additional impacts and restoration of these species and their habitats. For aquatic species, the analysis looks at how the management alternatives for forest plan revision either contribute to or mitigate common threats to factors of decline within Forest Service authority.

Affected Environment, Existing Conditions, and Trends

The analysis area for the watersheds, aquatic habitat, and species includes all lands within the boundary of the Forest. The variety of landscapes and associated aquatic ecosystems support an array of different aquatic, terrestrial, and botanical species.

While not considered in the immediate analysis area, it is important to understand the effects on nearby resources. Water for municipal, industrial, and agricultural purposes comes from the Sangre de Cristo range on the east side of the San Luis Valley, and the San Juan range to the west. The headwaters of the Rio Grande (Upper Basin) originate in the Forest, and most Forest watersheds drain into the Rio Grande river system. The headwaters of the Rio Grande provide much of the water resource for the downstream sections of the Rio Grande in the San Luis Valley of southern Colorado and New Mexico (Middle Basin). Floodwaters and droughts generated by the Upper Basin affect virtually all components of the Middle Basin (Scurlock 1998). Sustainability of ecosystems, and their significant human component, lies in understanding both basins together as one.

The Rio Grande and its parent landform, the Rio Grande Rift, dominate the physical setting that is the namesake for the Forest. The northern and eastern portions of the Forest drain primarily into the closed San Luis Basin. Within these areas, northern and western portions of the Sangre de Cristo Mountains from near Crestone Peak northward to the Hayden Pass area contain unique calcareous geology. This creates unique and important aquatic, riparian, and wetland ecosystems. Another landscape attribute that heavily influences aquatic, riparian, and wetland characteristics on the Forest is past glaciation. Terminal and lateral moraines created confined basins where impounded subsurface or surface water allows peat accumulation (Windell et al. 1986; Cooper 1990; Cooper 2005), whereas kettle ponds promote fen formation along these margins. In addition, glaciation has created wide, relatively level mountain valleys where large wetland complexes tend to form (Rocchio 2006).

The aquatic systems have been subject to a wide array of disturbances and events. These disturbances have often been intense and cyclic in nature. The watersheds and their dependent resources have evolved under this “pulse” disturbance regime so that they can effectively respond to those natural disturbances while sustaining long-term functions, processes, and conditions. Included are recent disturbances to spruce-fir forest ecosystems from spruce beetle that have likely increased light penetration and subsequently increased stream temperatures.

Around the beginning of the 19th century, the expansion of human populations increased in the San Luis Valley along with the development of the land and resources to support those populations. This has resulted in many new human-caused disturbances to the watershed systems, including sheep grazing and improved irrigation techniques. The pattern of many of those disturbances has tended to be a more sustained or “press” disturbance regime. A press disturbance forces an ecosystem to a different domain or set of conditions (Yount and Niemi 1990; Lake 2000). Many of those disturbances tend to mimic historic “natural” processes, but the frequency increases and intensity decreases creating a constant “press” condition. In some cases, the watershed systems that have been continually pressed have undergone regime changes (Stanley et al. 2010); creating stressors to aquatic dependent resources.

Man-made stressors can directly or indirectly degrade or impair key ecosystem characteristics important to aquatic habitat values. Human activities have altered Forest stream channels by direct modification such as stream diversions, reservoir/dam construction, transportation infrastructure (i.e., roads, unpaved stream crossings, trails, and off-highway vehicle use), and developed recreation sites that have encroached on riparian areas and stream channels (USDA Forest Service 2016). Humans have also indirectly affected the incidence, frequency, and magnitude of disturbance events. This has affected inputs and outputs of sediment, water, and vegetation. These factors have combined to cause changes in channel conditions throughout many parts of the Forest, resulting in aquatic and riparian habitat conditions that are different from those that existed prior to human development. Natural events including primarily wildfire, floods, and landslides, combined with management activities such as timber harvest, fire suppression, road construction, mining, dams, introduction of nonnative species, recreation, and grazing over the last two centuries have led to changes in the physical watersheds and in the fish that are dependent on them (Pritchard and Cowley 2006; Poff et al. 2011).

Roads can have some of the greatest effects to watersheds and aquatic biota. Roads can change the runoff characteristics of watersheds, increase erosion, alter sediment composition and nutrient delivery to streams, and alter channel morphology (Furniss et al. 1991; Gucinski et al. 2001; Trombulak and Frissell 2000; Grace and Clinton 2007; Silins et al. 2014). These direct effects lead to changes in habitats for fish. Roads and road networks under Forest jurisdiction can be managed to reduce or potentially eliminate negative impacts to aquatic, riparian, and wetland ecosystems. The benefits that accrue to aquatic and wetland ecosystems by correctly designing, constructing, and maintaining National Forest System roads are many. Considering the likely future increase in road use, the probability of incurring additional resource damage and destruction to aquatic, riparian, and wetland ecosystems is relatively high. Appropriate road and travel management will be necessary, and will include managing the transportation system and removing unwanted roads. Locating roads away from streams undoubtedly reduces sediment delivery into streams.

For the aquatic and riparian ecosystems, a recent assessment summarized the current conditions, system drivers, and stressors on the Forest (Assessment 1 and 3, Aquatic USDA Forest Service 2016). One of the key discussions in that assessment included the past and potential future effects of beaver. Beaver (*Castor canadensis*) are habitat-modifying keystone species in lotic, riparian, and wetland habitats (Collen and Gibson 2001), and their dam-building activities can influence a large proportion of a given watershed and landscape (Naiman et al. 1988). Beaver are an integral part of most headwater stream ecosystems in the Intermountain region (Wohl 2001), where their activities can alter stream channels and riparian zones and affect basic processes such as nutrient cycling (Naiman et al. 1986, 1988). Beaver impoundments generally have a positive effect on aquatic, riparian, and wetland ecosystems because they:

- elevate water tables and enhance riparian vegetation (Olson and Hubert 1994),
- create deeper water habitats with velocity and thermal refugia (Hagglund and Sjoberg 1999),
- decrease water velocities and promote sediment retention (Naiman et al. 1988),
- improve water quality by facilitating riparian habitats that intercept nutrient and chemical contaminants (Olson and Hubert 1994), and
- buffer against floods and summer droughts (Olson and Hubert 1994).

These beaver-induced hydrologic and biogeochemical changes also affect aquatic, riparian, and wetland biota. Beaver impoundments typically facilitate sediment deposition and storage (Wohl 2001), but in their absence, sediment might be transported farther downstream and be deposited in crucial fish spawning habitats. Hydrographs for the Rocky Mountain region are likely affected by loss of beaver impoundments because water storage capacity in first through fourth order streams is reduced. Thus, water is delivered more quickly in the absence of beaver dams, rather than being slowly released to buffer against periods of low flow. There is an opportunity for beaver to play a major role in achieving watershed and aquatic ecosystem health objectives on the Forest.

Rio Grande Cutthroat Trout

The Rio Grande cutthroat trout subspecies occurs in southern Colorado and New Mexico in five genetic management units that are managed primarily by State agencies, but the majority of occupied waters are within lands managed by Federal agencies. These genetic management units are managed to maintain genetic and ecological diversity where it exists to ensure representation of the subspecies across its historical range. Rio Grande cutthroat trout are typically restricted to headwater streams. Core populations are greater than 99 percent genetically pure and represent the historic genome of the native trout. Core conservation populations are self-sustaining Rio Grande cutthroat trout populations that are greater than 90 percent genetically pure and are managed at the same conservation level as core populations. Additional recreational populations have been established in high-elevation lakes, typically within wilderness.

Rio Grande cutthroat trout is currently distributed in about 122 populations, and most are isolated from other populations. The total amount of currently occupied stream habitat is estimated to be 11 percent (810 miles) of the historically occupied range. This large decline in distribution and abundance is primarily due to the introduction and impacts of nonnative trout (U.S. Fish and Wildlife Service 2014a). Species threats and range reduction led to the consideration of special protection granted under the Endangered Species Act with a recent decision to not list the species based primarily on ongoing conservation activities including those by the Rio Grande Cutthroat Trout Conservation Team (U.S. Fish and Wildlife Service 2014b).

In 2014, the Rio Grande cutthroat trout was removed as a candidate for listing as federally endangered or threatened. The U.S. Fish and Wildlife Service concluded in a 12-month finding that listing was not warranted at that time. Current management actions, threats, and overall population status were factors that were included in the analysis (U.S. Fish and Wildlife Service 2014b).

Many Rio Grande cutthroat trout conservation populations currently occupy lands administered by Federal agencies. Of the total 810 miles of estimated occupied habitat, the majority (59 percent) occurs within Forest lands, including 17 core and core conservation populations of Rio Grande cutthroat trout in the analysis area occurring in the Rio Grande Headwaters Genetic Management Unit (Alves et al. 2008, Rio Grande Cutthroat Trout Conservation Team 2013, Inland Cutthroat Trout Viewer 2016). A small portion of the Lower Rio Grande Genetic Management Unit is within the analysis area and includes the Chama Basin, but no current core or core conservation populations occur within this genetic management unit. Rio Grande cutthroat trout occupy about 154 miles in 30 streams and multiple lakes on the Rio Grande (Rio Grande Cutthroat Trout Conservation Team 2013).

Rio Grande Chub

Rio Grande chub (*Gila pandora*) occurs in the Rio Grande, Pecos, and Canadian drainages in New Mexico, with populations in the Rio Grande and San Luis closed basins of Colorado and an isolated population in the Davis Mountains of Texas (Sublette et al. 1990). Sublette et al. (1990) considered the species to be stable in New Mexico. However, Rio Grande chub is a species of greatest conservation need in the State Wildlife Action Plan for New Mexico (New Mexico Department of Game and Fish 2016). Recent sampling has found Rio Grande chub to persist in most locations where the species was historically documented in New Mexico, but the species was recently considered non-indigenous to the Canadian drainage basin (Fuller 2017). Unique isolated populations occur in the lower Rio Grande (Alamosa Creek) and Pecos drainages (Rio Bonito and Rio Peñasco) of New Mexico (Galindo et al. 2016). In Colorado the Rio Grande chub is currently a species of concern, while in Texas, it has a status of state threatened (Hubbs et al. 2008).

Rio Grande chub is currently petitioned for federal listing under the Endangered Species Act, with a positive 90-day finding that warrants the further status review for the species (U.S. Fish and Wildlife Service 2016).

Rio Grande chub populations are rare on the Forest, primarily occurring in Colorado at elevations below 9,000 ft. A population occurs within Hot Creek and possibly upstream of Terrace Reservoir within the Forest boundary in the Alamosa River drainage. Other populations near the Forest boundary may occur in Saguache Creek and Hodding Creek and other lower elevation sites located within the San Luis closed basin (Bestgen et al. 2003; Rees et al. 2005).

Rio Grande Sucker

Rio Grande sucker primarily occurs in cool-water stream habitats of the Rio Grande, Mimbres, and Gila drainages of New Mexico. An additional population in the Pecos drainage occurs in the Rio Hondo of New Mexico but may be the result of human introduction. The species also occurs in the Rio Grande Basin in Colorado and three states of Mexico; Durango, Chihuahua, and Zacatecas (Sublette et al. 1990). It is considered a species of greatest concern in New Mexico (New Mexico Department of Game and Fish 2016) and is considered state endangered in Colorado (Swift-Miller et al. 1999).

Rio Grande sucker is currently petitioned for federal listing under the Endangered Species Act, with a positive 90-day finding that warrants the further status review for the species (U.S. Fish and Wildlife Service 2016).

Rio Grande suckers have been reintroduced in several Colorado streams in the Rio Grande basin and San Luis closed basin including locations within the Forest (Rees and Miller, 2005). The following aquatic systems have received transplanted fish within the Forest: Cascade Creek, Lake Fork Conejos River, Medano Creek, Middle Carnero Creek, North Carnero Creek, Osier Creek, and San Francisco Creek. Successful reproduction has only been confirmed in the Lake Fork Conejos River, North Carnero Creek, Middle Carnero Creek, and Medano Creek populations (Rees and Miller 2005, Jones 2017).

Direct and Indirect Effects

Nearly all land management direction implemented and described in this analysis has the potential to indirectly, adversely affect aquatic and riparian resources to some degree. Activities that alter the quantity, timing, or quality of water resources have the greatest potential for adverse effects, and the risk of adverse effects generally decreases as the distance away from streams or wetlands increases.

Watershed conservation practices, best management practices, forest plan standards and guidelines, and management approaches prescribe extensive measures to protect soil, riparian, and therefore aquatic ecosystems. When applicable measures are implemented and effective, adverse effects to these resources from management activities will be minimized or eliminated. Indirect effects related to this planning effort from specific programs and decisions are summarized below.

Effects on Aquatic Ecosystems from Vegetation Management

As described in the *Watershed Resources* and *Soils* sections, the greatest impacts related to timber harvest on fisheries may be from road construction or reconstruction, as well as from the subsequent sedimentation and nitrification contributing to degrade fishery habitat (Silins et al. 2014). The impacts from mechanical fuels reductions, rangeland treatments, and timber sales on the magnitude, timing, and duration of streamflow, and on water quality, are described in the *Watershed Resources* section. Other vegetation management, including utility corridors and Wolf Creek Ski Area modifications and expansions, may result in impacts that are similar to those presented in the *Watershed Resources* section and in the *Soils* section.

Beyond the effects of sediment from vegetation management, fisheries and aquatic species can be impacted by a reduction of streamside vegetation. Some reduction in streamside vegetation and average annual and average daily stream temperature can increase by reducing shade and decreasing the recruitment of large woody debris in streams. Overhanging vegetation provides cover for fish and helps cool stream temperatures. Large woody debris recruitment is important because it dissipates erosive stream energy, regulates sediment movement downstream, provides nutrients, and creates pools important to aquatic species.

By alternative, the greatest impacts to aquatic ecosystems from vegetation management would be under alternative C, followed by alternatives A, B, and D. Alternative C proposed to increase the area that is considered suitable for timber harvest to capture value from spruce-fir impacted by beetles and has the potential to impact aquatic ecosystems the most. Suitable timber acres varies by alternative and is inverse to the additional amount of evaluated wilderness and other designated areas put forward in alternative D. All of the action alternatives contain updated plan components, which provide adequate protection for aquatic ecosystems. The relative impacts are based primarily on the effects determination in the *Watershed Resources* and *Soils* sections, with the corresponding impacts on fish habitat from sediment and increased stream temperatures similar.

Effects on Aquatic Ecosystems from Fire Management

Prescribed burns may result in considerably less severe impacts compared to wildfire. Under prescribed burns, the location and severity of the fire are controlled to a greater extent; therefore, more ground cover would remain and the erosion potential would be reduced. Sediment trapping buffers would generally remain around stream channels in order to reduce the amount of sediment delivered to the stream. Rarely do entire watersheds burn as a result of prescribed burns or wildfires managed for multiple resource benefits. These treatments are beneficial because they can reduce the impacts of changes in water yield and peak flows due to conditions such as drought. Furthermore, the careful and judicious use of prescribed burns may help reduce the risk of uncontrolled wildfires that may otherwise burn through and severely damage watersheds and riparian areas, increase erosion and sedimentation, and degrade large segments of fishery habitat.

The updated fire management zones and the plan components related to these and riparian management zones provide similar protections for aquatic ecosystems among all action alternatives (B, C, and D). Specifically, the use of guidelines and best management practices put forward in “Guide to Preventing Aquatic Invasive Species Transport by Wildland Fire Operations” provides protection related to the incidental introduction of invasive species (National Wildfire Coordinating Group 2017). Additionally, updates and use of the terrestrial and aquatic aerial fire retardant avoidance maps provides protection under all action alternatives (USDA Forest Service 2017)

Effects on Aquatic Ecosystems from Livestock Grazing

The general impacts related to livestock grazing on aquatic ecosystems are discussed in the *Watershed Resources, Riparian Management Zones,* and *Soils* sections. Specifically, the primary impact to fisheries and aquatic species would be mainly due to degraded habitat resulting from erosion and sedimentation and increased stream temperatures caused by long-term concentrated grazing in riparian areas where streambank trampling and trailing, stream widening, and streamside vegetation removal can occur, resulting in insufficient overhead cover for fish (Platts 1991). Another impact to fisheries and aquatic species would be due to the construction of new stock ponds, and livestock water and the resulting water depletion and potentially reduced streamflows. Application of plan direction in alternatives B, C, and D should ensure proper grazing management and reduce the effects to fisheries and aquatic ecosystems.

Overall, the long-term impacts related to livestock grazing on aquatic ecosystems would be minor. Impacts vary little by alternative because suitable and available livestock grazing acreages are unchanged. The corresponding impacts on fish habitat from sediment and increased stream temperatures would therefore also be similar.

Effects on Aquatic Ecosystems from Roads and Trails

The primary impacts to aquatic ecosystems related to roads and trails are on streamflow and sediment production and are described in the *Watershed Resources* and *Soils* sections. Specifically, with regard to aquatic ecosystems, heavy sediment loads can reduce pool depths, bury stream substrates and spawning gravels, adhere to aquatic insects and the gills of fish, increase habitat for tubifex worms (*Tubifex tubifex*) (an intermediate host for whirling disease), alter channel form and function, and result in other forms of habitat degradation. Improperly placed, shaped, and sized culverts can act as fish barriers on key streams or exacerbate erosion and, in turn, result in head-cutting. For any given watershed, the overall risks of impacts to aquatic ecosystems due to roads tend to increase with new road construction or reconstruction. Conversely, risks of impacts to aquatic and riparian ecosystems tend to decrease with road closure. Road maintenance may result in short-term increases in soil erosion; however, routine road maintenance provides opportunities to stabilize road features and improve road drainage. The location of roads is also an important consideration when minimizing erosion and sedimentation of streams. Roads adjacent to stream channels can potentially increase sedimentation and restrict channel meander or increase stream slope, causing the stream to down-cut and erode. The relative impacts of roads on aquatic resources are based on changes in use and management practices by alternative. Through application of plan direction (especially related to riparian management zones and activity periods), alternative D, followed by alternatives B, A, and C, will more effectively minimize potential impacts to fisheries and aquatic ecosystem, respectively.

Effects on Aquatic Ecosystems from Developed and Dispersed Recreation

Colorado Parks and Wildlife laws and regulations are adequate to prevent over-exploitation of fish populations through angling with catch and release fishing for core conservation populations of Rio Grande cutthroat trout throughout most of the Forest. Bait bucket and stocking regulations protect Rio Grande cutthroat trout and other native sensitive species of fish, including Rio Grande sucker and Rio Grande chub. There is some incidental mortality to Rio Grande cutthroat trout when they are caught and released, but this was determined not to be a factor when the species was recently evaluated for federal listing (U.S. Fish and Wildlife Service 2014b). Habitat alteration from recreational camping and day-use sites might cause some site-specific impacts, but should not be extensive enough to measurably limit fish populations. Localized impacts to vegetation and banks in riparian areas occur at lakes with fish and at river access sites. Effects would be the same among all alternatives. There would be little to no effects on aquatic and riparian resources from fishing.

Increases in recreational visitors increase risks to aquatic communities. The greatest threat from recreation is introduction of aquatic invasive species. These species include any nonnative plant or animal species and disease that threatens the diversity or abundance of native species, the ecological stability of infested waters, or commercial, agricultural, or recreational activities dependent on such waters. Some include zebra and quagga mussels, New Zealand mudsnail, whirling disease, and nonnative fish. While nonnative fish such as brook and rainbow trout are desirable in many locations, there are places where they are not. For example, in wilderness, continued implementation of alternative A, stocking of trout was restricted to Rio Grande cutthroat trout to support the species while providing recreational opportunities for backcountry anglers.

Most of the pathways of introduction and spread of aquatic nuisance species are related to human activities, both accidental and intentional. Aquatic invasive species (i.e., zebra and quagga mussels) can be accidentally transported and spread by way of recreational boats and wading boots. Education and outreach will continue to be important to prevent the increased spread of these species, and the Forest Service Rocky Mountain Region continues to support Colorado Parks and Wildlife and other cooperators to set up key check stations for aquatic invasive species throughout Colorado.

Developed winter recreation does not affect aquatic species except for possible sediment inputs resulting from new construction, grooming, or maintenance at Wolf Creek Ski Area. The effects would be the same across all alternatives.

Effects on Aquatic Ecosystems from Designation of Wilderness, Wild, Scenic, and Recreational Rivers, Research Natural Areas, and Special Interest Areas

The primary impacts on aquatic ecosystems related to newly designated areas on the Forest are discussed for wilderness, wild, scenic and recreational rivers, research natural areas, and Special Interest Areas, respectively. Alternative D would increase the amount of acres that are analyzed for wilderness over the other action alternatives. This alternative proposes additional special interest areas and areas focused on improving and maintaining habitat for native fish as well as areas based on notable cultural, zoological, and botanical resources and tribal uses. Alternative D proposes additional designated areas that would maximize the connectivity of habitat and increase opportunities for primitive and semiprimitive visitor experiences, including native fish habitat areas in Carnero Creek and Jim Creek.

Deadman Creek is being evaluated for inclusion as a scenic river in all action alternatives. One of the outstanding remarkable values identified for Deadman Creek was the presence of Rio Grande cutthroat trout. Deadman Creek also could provide habitat for Rio Grande sucker and chub restoration activities if warranted.

Recreation pressure may increase for newly identified areas, including fishing, but this is not expected to be substantial, as most of these are relatively remote or little used by the public. In a few cases, additional monitoring may be needed to identify pressures.

The management of specially designated areas provides significant protections for aquatic ecosystems regardless of alternative, but alternative D, followed by alternatives B, C, and A provide for more effective management.

Revised management direction in all action alternatives to address habitat connectivity and ecosystem integrity related to aquatic ecosystems applies regardless of the designations listed above.

Effects on Aquatic Ecosystems from Mineral Resource Activities

Within the planning area, mining activities may include suction recreational dredging, gravel mining operations, and hard-rock mining. Generally, gravel pits are situated away from riparian areas and tend not to impact aquatic species. Mining claims and mineral leases on the Forest are not expected to change by alternative.

The primary impacts related to mineral extraction on the Forest are on water quantity and water quality; these are discussed in the *Watershed Resources* section. Additional impacts of concern to fisheries and aquatic species related to mining or mining reclamation would be mainly due to erosion and sediment impacts (i.e., degraded fishery habitat), heavy metal loading of streams (i.e., toxic levels for aquatic species), altered stream channels, or both, and associated fishery habitat at critical times, especially for Rio Grande cutthroat trout. Alternatives B, C, and D have identical plan direction identifying preferred instream activity periods that, when applied to recreational dredging, provide improved direction and protect sensitive spawning and recruitment periods for core populations of Rio Grande cutthroat trout, as well as other native and desired nonnative species (see the *Rio Grande National Forest Draft Revised Land Management Plan*). Forest plan components combined with project-specific mitigation are expected to protect aquatic species across all alternatives related to mineral extraction.

Cumulative Effects

The potential cumulative effects from forest programs to water quality would generally be discussed at the Forest level. The temporal scale for this analysis will be limited to the life of this plan. Watershed conservation practices and forest plan standards prescribe extensive measures to protect riparian function and minimize effects caused by active forest management (MacDonald and Stednick 2003, Thomas et al. 2006, Reeves et al. 2006, Reiter et al. 2009). If all applicable measures are implemented and if they are effective, then adverse effects from any of the alternatives should be minimized. It is unlikely that plan components will prevent all adverse effects from occurring for each and every action that may be implemented on the Forest. Therefore, alternatives that propose higher levels of activity for various resources pose greater inherent risks to aquatic and riparian resources. Broadscale outcomes were qualitatively estimated for effects on hydrologic function and watershed processes for Forest lands within the project area.

Actions taken to implement any of the alternatives, along with past, present, and foreseeable future activities undertaken in the planning area (or other nearby jurisdictions, including local, state, Native American tribal, and other federal actions, as well as private) could result in cumulative impacts. The cumulative impacts analysis covers the implementation timeframe of the approved forest plan and includes lands and aquatic systems within or downstream of the planning area. Other reasonably foreseeable projects in the analysis area that may cumulatively affect aquatic ecosystems include forest plan revision for the Carson National Forest and Grand Mesa, Uncompahgre, and Gunnison National Forests, as well as ongoing management for Great Sand Dunes National Park, Rio Grande del Norte National Monument, Baca National Wildlife Refuge, and other federal and state lands within the San Luis Valley. Ongoing operations and future development at Wolf Creek Ski Area are also included, and considered relative to increased sedimentation and water quality impacts to aquatic ecosystems.

While forest plan revision is ongoing with two of our shared boundary forests (Grand Mesa, Uncompahgre, and Gunnison and the Carson National Forests), only the Carson National Forest has aquatic systems that are both upstream and downstream, and provides important aquatic connectivity in the Rio Chama and Conejos River Basins. Shared management of Rio Grande cutthroat trout in these areas provides additional protection for the species (Rio Grande Cutthroat Trout Conservation Team 2013). Almost all headwater stream systems of the Rio Grande originate on the Forest and eventually flow downstream onto lands owned or administered by entities other than the Forest Service, including the Rio Grande del Norte National Monument, and therefore cumulative impacts for this monument would be negligible.

Importantly, ongoing restoration management of native fish species is occurring and will continue to occur off-Forest in other areas of southern Colorado and the San Luis Valley, including in Great Sand Dunes National Park (Rio Grande cutthroat trout) and Baca National Wildlife Refuge (Rio Grande sucker and Rio Grande chub). Successful restoration efforts on nearby populations within the Upper Rio Grande Genetic Management Unit for Rio Grande cutthroat trout (Rio Grande Cutthroat Trout Conservation Team 2013), or similar efforts for other species, contribute to the management as a whole and further reduce the likelihood of future federal listings, especially with support of these efforts by the Forest.

As the result of introductions of nonnative fish species and past local and regional cumulative impacts, the Rio Grande cutthroat trout is a species of conservation concern. The primary adverse cumulative impacts, under all of the alternatives, would continue to occur as a result of further introductions where Rio Grande cutthroat trout are currently managed or could be considered for reintroduction. Depending on the location of ground-disturbing activities, the cumulative impacts of sedimentation may range from no impact to adverse for certain stretches of stream habitat and individual fish, especially in headwater systems (i.e., Wolf Creek Ski Area); however, that would be at the site-specific, project-level analysis.

Summary of Effects

Based on the analysis of all alternatives, including alternative A, other interrelated and interconnected activities, and the cumulative effects of other federal and non-federal activities in the planning area, the implementation of the plan components for alternatives B, C, and D would provide the ecological conditions that support persistence of the three fish species of conservation concern: Rio Grande chub, Rio Grande cutthroat trout, and Rio Grande sucker. With the additional land management options put forward in alternative C, additional monitoring would likely be required to adequately determine success in meeting plan component direction. Alternative D on the other hand would provide additional protection, especially with the added wilderness and wild, scenic, and recreational river areas to analyze. As noted in the *Effects on Aquatic Ecosystems from Designation of Wilderness* section, these roadless areas tend to contain sources of high quality water and provide protection in the face of climate change and foundations for restoration of larger watersheds (Isaak et al. 2010, Isaak et al. 2015).

Watershed Resources

Overview

Concerns over watershed health and the continued availability of usable water supplies in the American West contributed to the creation of the original forest reserves in 1891. The subsequent Organic Act of 1897 summarized these concerns by declaring that “no public forest reservation shall be established, except to improve and protect the forest within the reservation, or for the purpose of securing favorable conditions of water flows.” The original reports on the forest reserves that would eventually compose the Forest’s highlighted watershed conditions and deleterious practices that could eventually threaten the function of various basins. Recommendations to manage these lands as forest reserves were, in part, intended to preserve the ability of rivers and streams to reliably deliver both the quality and quantity of water necessary to sustain the agricultural economy of the San Luis Valley. Goal 1 as expressed in the proposed forest plan to protect and restore watershed health, water resources, aquatic ecosystems, and the systems that rely on them was developed in response to the importance of these resources.

To more effectively manage Forest lands of the San Luis Valley, the Forest was assembled from portions of three other national forests (the San Juan, San Isabel, and Cochetopa). Today the Forest manages about 37 percent of the land in Colorado’s San Luis Valley, and an estimated 60 percent of the annual precipitation falls on Forest lands (PRISM Climate Group 2017). As a result of these large, high-elevation holdings, the Forest plays a unique and vital role in managing watershed resources and delivering water to the valley floor to support a variety of beneficial uses.

Affected Environment

General Hydrologic Setting

The Forest occupies the headwaters of the Rio Grande, which flows nearly 2,000 miles from the Continental Divide in southwestern Colorado to the Gulf of Mexico. Bounded by the Continental Divide to the north and west, and the Sangre de Cristo Range to the east, Forest lands occupy an upper elevation “horseshoe” around the San Luis Valley (Figure 1). The Forest contains portions of six sub-basins, which are further divided into 38 watersheds and 166 sub-watersheds (Assessment 2 (USDA Forest Service 2016)). The basins and subsequent divisions are identified by a hydrologic unit code or HUC: Rio Grande Headwaters, HUC 13010001; Alamosa-Trinchera, HUC 13010002; San Luis, HUC 13010003; Saguache, HUC 13010004; Conejos, HUC 13010005; Rio Chama, HUC 13020102. A map of the *Rio Grande*

Headwater System and a map of *HUC 12 Watersheds and Priority Watersheds* are both contained on the DVD located at the back of this document.

Forest lands typically extend downward from the upper portions of watersheds, with lower boundaries well above the floor of the San Luis Valley. Precipitation correlates with elevation, with areas along the Continental Divide receiving 50 inches or more of mean annual precipitation and the valley floor receiving as little as 7 inches. This elevational gradient is exacerbated by the fact that much of the low-elevation precipitation is evaporated or transpired prior to contributing to streamflows (Assessment 2). The overall dominance of mountain snowpack in the hydrologic cycle produces streamflow runoff patterns that have a pronounced snowmelt-driven spring peak, with a recession to base flows by late summer. Monsoonal storms have potential to generate high localized discharges from basins receiving precipitation. Additionally, early fall snowpack that is subsequently subjected to rainfall has the potential to generate discharges similar in magnitude to springtime peak flows. Given these realities, Forest lands produce a majority of both runoff and aquifer recharge, which is vital for the agricultural success of the San Luis Valley (Wenger et al. 2010). On average, these watersheds generate about 1.5 million acre-feet of water per year. An estimated 1.3 million acre-feet flows from the San Juan range while the remaining 200,000 acre-feet flows from the Sangre de Cristo range.

There are approximately 11,027 miles of stream channels on the Forest; of these, 1,820 miles are perennial. Additionally, there are 3,161 acres of water bodies, of which 91 percent are perennial. Groundwater resources beneath the floor of the San Luis Valley are extensive, and both confined and unconfined aquifers are heavily used. North of the Rio Grande, groundwater resources operate as a closed basin, with no natural hydrologic connection to the Rio Grande or lower basin water resources. With the exception of recharge zones and alluvial fill along major river corridors, groundwater resources on Forest lands are typically disconnected from those of the valley floor. Moving into mountainous terrain, groundwater resources in the alluvium are separated from the deep crystalline-rock aquifers. The Forest also has an estimated 23,000 acres of seeps, springs, and wetlands that are sustained via groundwater and host groundwater dependent ecosystems.

Existing Conditions and Trends

The Forest Service uses the watershed condition framework to asses and characterize the health and condition of watersheds at the 6th level Hydrologic Unit Code (HUC). Of the 166 6th level HUCs that have Forest lands, 14 have less than 5 percent Forest lands and have been excluded from analysis. The outcome of watershed condition framework analysis is that each of the 152 6th level watersheds with more than 5 percent of the lands managed by the Forest has been assigned to one of three classes to describe watershed condition.

Class 1 or good condition watersheds are functioning properly because they exhibit high geomorphic, hydrologic, and biotic integrity relative to their natural potential condition. Class 2 or fair condition watersheds are functioning at risk because they exhibit moderate geomorphic, hydrologic and biotic integrity relative to their natural potential condition. Class 3 or poor condition watersheds are at impaired function because they exhibit low geomorphic, hydrologic and biotic integrity relative to their natural potential condition.

Overall watershed condition classifications (Figure 18) show that 77 (50 percent) of the 152 watersheds are functioning properly, another 74 (49 percent) are functioning at risk, and only 1 watershed has impaired function, Cottonwood Creek-Kerber Creek (HUC 130100030102) due to the effects of historic mining. Concerns with water quality, aquatic habitat, aquatic biota, riparian and wetland vegetation, soils, and rangeland vegetation condition are major contributors to the impaired classification.

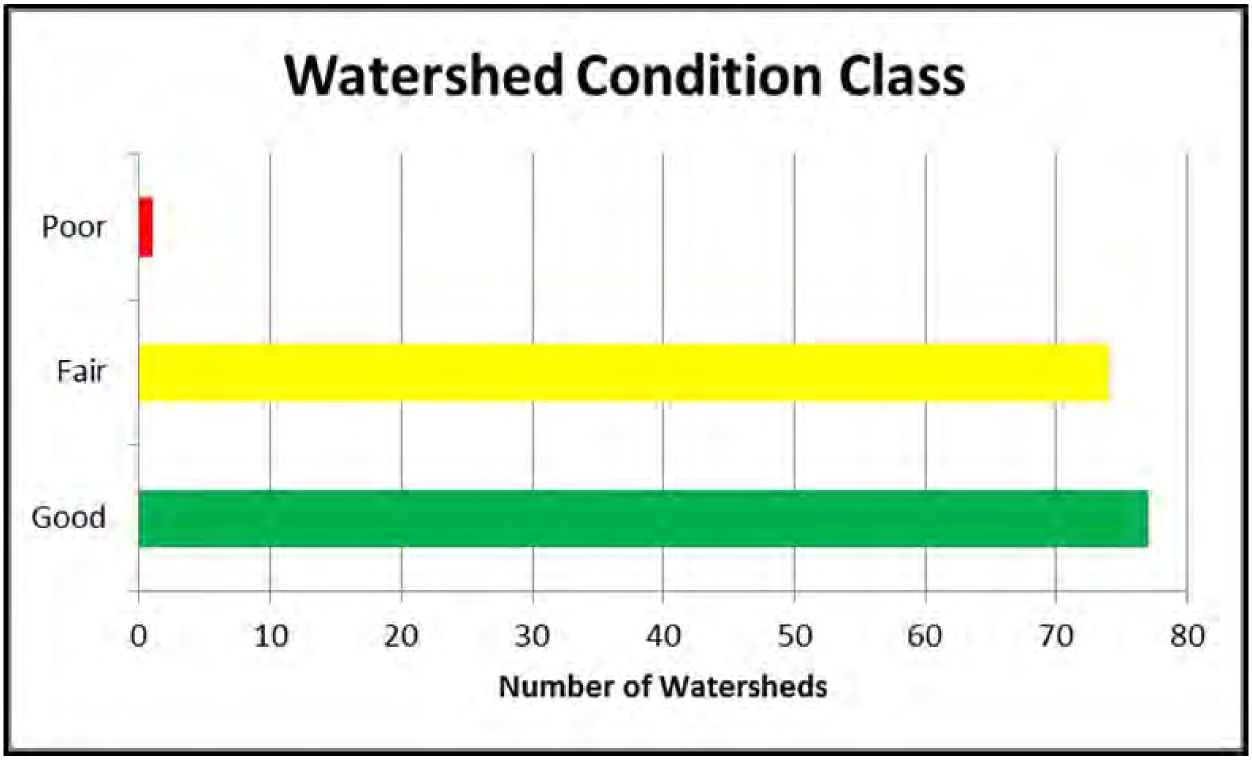


Figure 18. Watershed condition class, 2012

Further analysis of the individual categorical data shows broader trends and associated risk factors that have caused watersheds to be downgraded from Class 1 to Class 2. The watershed condition indicators that are most heavily influencing the reported condition classifications are water quality, aquatic habitat, aquatic biota, riparian/wetland vegetation, roads and trails, soils, and rangeland vegetation. Assessment 2 identified the following land uses and activities that are influencing these attributes the most:

- uncontrolled motorized recreation,
- historical and current livestock grazing in both uplands and riparian areas/wetlands,
- lack of road and trail maintenance,
- introduction of exotic and invasive aquatic and terrestrial species, and
- natural range of variation issues relative to fire regimes and insect and disease activity.

More detailed analysis and discussion of watershed condition indicators is contained in Assessment 2.

Water quality across the planning area is generally good, with 28 waterbodies listed as impaired on the State of Colorado 303(d) monitoring and evaluation list (Table 45). For the Rio Grande headwaters, 74 percent of all stream miles support at least one, and typically all, classified water uses. The numbers are substantially lower for reservoirs and lakes; however, the vast majority of impoundments in the basin reside off of Forest lands. Most waterbodies listed are present due to unacceptable heavy metals loading and pH levels related to legacy impacts from mining. Many of these stream segments have benefitted from substantial restoration efforts and even superfund designation, particularly the Alamosa River and Willow Creek near Creede.

Table 45. 303(d) listed impaired waterbodies in the Rio Grande Basin, 2016

Waterbody Identification	Segment Description	Portion	Clean Water Act Section 303(d) Impairment	303(d) Priority
CORGAL03d	Alamosa River, from Ranger Creek to Terrace Res.	all	Aluminum	High
CORGAL13	Hot Creek from source to La Jara Creek	all	Iron(Trec)	High
CORGAL20	Rio Grande, tributaries within the Rio Grande Forest	all	pH	High
CORGAL25	All lakes and reservoirs tributary to La Jara Creek from the source to Hot Creek.	La Jara Reservoir	Dissolved oxygen	High
CORGCB02a	La Garita Creek, including tributaries from the source to Geronimo Creek. The North, Middle and South Forks of Carnero Creek, including tributaries from their source to mainstem of Carnero	North Fork Carnero Creek	Arsenic, Aquatic Life	High
CORGCB02a	La Garita Creek, including tributaries from the source to Geronimo Creek. The North, Middle and South Forks of Carnero Creek, including tributaries from their source to mainstem of Carnero	South Fork Carnero Creek	Arsenic	High
CORGCB02b	La Garita Creek, source to 38 Rd, Carnero Creek, source to 42 Rd	La Garita Creek	Aquatic Life, Arsenic	High
CORGCB02c	Mainstem Carnero Creek from inception to 42 Road	all	Arsenic	High
CORGCB03	All tributaries to closed basin except those in 2a, 2b, 2c, and 4-13	Willow Creek	Copper	High
CORGCB04	San Luis Creek, from source to Piney Creek	all	Arsenic	Low
CORGCB09b	Kerber Creek from Brewery Creek to the confluence with San Luis Creek.	all	Arsenic	Low
CORGCB09b	Kerber Creek from Brewery Creek to the confluence with San Luis Creek.	Kerber Creek from US Gulch to the confluence with San Luis Creek	Aquatic Life (provisional)	High
CORGCB12a	Saguache Creek including all tributaries from the boundary of the La Garita Wilderness Area to Ford Creek	all	Arsenic, Iron(Trec)	High /Low

Waterbody Identification	Segment Description	Portion	Clean Water Act Section 303(d) Impairment	303(d) Priority
CORGCB12a	Saguache Creek including all tributaries from the boundary of the La Garita Wilderness Area to Ford Creek	East Pass Creek	Sediment	High
CORGCB19	San Luis Lake	all	Ammonia, Iron(Trec)	High
CORGRG02	Rio Grande River, source to Willow Creek	South Clear Creek	Iron(Trec)	High
CORGRG04a	Rio Grande, just above Willow Creek to confluence with South Fork Rio Grande	all	Lead	High
CORGRG04b	Rio Grande from South Fork Rio Grande to Hwy 285	all	Temperature	High
CORGRG04b	Rio Grande from South Fork Rio Grande to Hwy 285	S Fork Rio Grande to Del Norte	Arsenic	Low
CORGRG04b	Rio Grande from South Fork Rio Grande to Hwy 285	Del Norte to Highway 285	Copper	High
CORGRG04c	Rio Grande from Hwy 285 to County Line	all	Arsenic, Copper	Low / High
CORGRG07	West Willow Creek, East Willow Creek, Willow Creek and tributaries	all	Cadmium, Lead, Zinc	M
CORGRG09	South Fork Rio Grande and tributaries from source to Rio Grande	North Branch of Pass Creek	Arsenic, Zinc	Low / High
CORGRG11	Mainstem of San Francisco Creek (Rio Grande County), including all tributaries, from the source to Spring Branch	all	Aquatic Life, Arsenic	High / Low
CORGRG12	Mainstem of the Rio Grande from the Rio Grande/Alamosa County line to the Old State Bridge east of Lobatos (Conejos County Road G)	all	Aquatic Life (provisional)	Low
CORGRG19	Rock Creek from source to Monte Vista Canal	all	Arsenic	Low
CORGRG20a	Cat Creek and tributaries from source to Forest	all	Aquatic Life	High
CORGRG28	Rito Seco, from source to Salazar Reservoir	Upper Rito Seco below Battle Mountain	E. coli	High

All public water supplies in the San Luis Valley use water that either wholly or partially originates on Forest lands. In 2014 the Rocky Mountain Region of the Forest Service entered into a memorandum of understanding with the Colorado Department of Health and the Environment to recognize department-delineated source water protection areas as municipal supply watersheds. As a consequence, Forest lands in these areas receive additional consideration during planning to maintain the quantity and quality of water originating in these watersheds.

Given the relative lack of long-term monitoring data on watershed condition, trend assessment is difficult at present. However, several inferences can be made based on alterations in land management practices over the last several decades. First, the amount of permitted and trespass grazing on the Forest has declined over time, likely resulting in improvements in watershed resource conditions, particularly riparian vegetation and streambank stability. Second, declines in timber harvest, and associated revegetation of harvested areas and previously used roads and skid trails, has likely reduced sediment delivery and decreased the connected disturbed areas in many watersheds. Finally, projects to decommission unnecessary roads and remedy problems associated with unauthorized roads and trails have been successful in reducing impacts to watershed resources.

Direct and Indirect Effects

A summary impacts analysis for watershed resources would rely primarily on an assessment of which management activities have the greatest ability to impact watershed resources, and which alternatives propose the greatest numbers of acres that are available to those management activities.

It can be reasonably anticipated that the greatest future impacts to watershed resources would come from those management activities that are already known to be primary influences on current forest conditions, namely system roads and trails, uncontrolled motorized use on unauthorized roads and trails, and livestock grazing in riparian areas (Assessment 2). Relative to natural conditions, these activities have the potential to lead to accelerated soil erosion and compaction, sediment delivery to streams and wetlands, and alterations to stream channel form and function. Expansion of both system road and unauthorized network of roads and trails would be the most likely activities to impact watershed resources.

In addition to the impacts discussed in the preceding sections, the Forest works with local partners to complete a wide variety of watershed restoration projects. These types of projects typically focus on the improvement of riparian vegetation and streambank stability, or correcting stream-road and stream-trail interactions that are causing increased erosion and sedimentation. The conduct of these restoration activities is not expected to vary by alternative.

Alternatives A through D essentially represent varying partitions of acreage among a variety of potential uses, ranging from restrictive management prescriptions (e.g., wilderness) to general forest areas that are suitable for harvest, grazing, and dispersed/motorized recreation. Among all alternatives the acreage of suitable rangeland remains nearly constant with the exception of small alterations based on special area designations. As a result, watershed resource impacts from livestock grazing would not vary significantly by alternative. Among the action alternatives, alternative D represents a minimization of acreages that would be available for expansion of the road/trail network, particularly for motorized vehicles and timber harvest. As a result, alternative D would likely have the fewest overall impacts to watershed resources. Alternatively, alternative C represents a maximum number of acres available for the potential expansion of the motorized trail network, and the maximum number of acres suitable for timber harvest and the necessary access roads. Consequently, alternative C would likely have the greatest impacts to watershed resources. The watershed impacts of alternative A would be similar in magnitude to those of alternative C, even with a reduced suitable timber base, due to the lack of designated areas and recommended wilderness. The potential watershed impacts of alternative B represent a relative midpoint among alternatives A, C, and D. None of the alternatives are likely to detrimentally impact municipal water supplies.

Effects on Watershed Resources from Vegetation Management

Timber harvesting and fuels treatments have the potential to impact watersheds and stream health. Impacts fall into two broad categories, impacts associated with the canopy removal itself, and impacts associated with the road network required for successful timber harvest, which are discussed later in this section. Major reductions in forest canopy can increase water yield in high-elevation forested watersheds such as spruce-fir or cool-moist mixed-conifer forests. These increases can be large in some areas. However, in the hydroclimatic regime of the planning area, annual climate variations are much more important than alterations from timber harvest. Flow increases occur mostly during spring runoff and during the summer; they are not measurable until 25 percent of the basal area of a forested watershed is affected (USDA Forest Service 1980). Large openings can suffer snow scour that can reduce site moisture and water yield (USDA Forest Service 2006).

Timber harvest treatments would be spread over time throughout many forested watersheds in the planning area; however, their exact amount, location, and timing is unknown until specific projects are proposed. It is not expected that watersheds would receive timber harvesting treatments that exceed 25 percent basal area removal over the life of the plan; therefore, detectable changes in water yield would, generally, not be a concern. On a site-specific basis, certain sensitive watersheds can have water yield concerns. Some watersheds are prone to mass failure and may be especially sensitive to small changes in water yield. Other watersheds have experienced large amounts of disturbance as result of past management activities, severe climatic events, or large wildfires, and may have water yield issues. Impacts to those watersheds is considered on a project-by-project, site-specific basis in order to evaluate water yield concerns. The appropriate forest plan direction would be applied to reduce these concerns.

Sediment is the primary pollutant associated with water quality impacts from timber harvest. Implementation of water conservation practices, best management practices, guidelines, and relevant forest plan direction applied to all timber harvesting activities are typically effective in preventing or reducing sediment delivery to water bodies. Road construction associated with timber harvesting has a higher potential to impact water quality. New road construction has the greatest potential for direct or indirect watershed impacts associated with timber harvesting (Megahan and Kidd 1972, Reid and Dunne 1984). Reconstruction on stabilized roads that are covered with vegetation can generate increased sediment (Swift 1984), just as new road construction is a large source of sediment to forested watershed streams. Vegetation management activities in the planning area will comply with the most current best management practices (USDA Forest Service 2012) to reduce these impacts.

There is no meaningful variation in the amount of fuels treatment proposed among the alternatives; therefore, the potential impacts to watersheds from fuels treatments would likely be identical under all of the alternatives. In general, fuels treatments would not be expected to result in measurable impacts to water yield because such treatments (including mechanical treatments and prescribed burns) primarily target the understory and small-diameter trees; therefore, they may not measurably alter basal area.

For timber harvest, the nature of impacts to watershed resources are consistent by alternative, but would vary in magnitude based on the acreage of suitable timber base, recommended wilderness, roadless management areas, and designated areas. Acres of suitable timber base vary substantially by alternative, with all action alternatives representing a substantial increase over alternative A. Based on acreage of suitable timber base and forest plan direction, alternative C would be expected to have the most watershed impacts from timber harvest, followed by alternatives A, B, and then D.

Effects on Watershed Resources from Livestock Grazing

Excessive or unrestricted grazing by permitted livestock and big game may result in widespread impacts on watershed health and water resources. Grazing pressure in sensitive areas may degrade watershed conditions through the direct, physical removal of riparian and wetland vegetation, and trampling of streambanks and wet areas, or through indirect changes to vegetation species composition, decreased shading/increased water temperatures, and changes in water chemistry. Areas commonly impacted by livestock grazing include mountain grasslands, riparian areas, wetland ecosystems, alpine vegetation, semi-desert grasslands, and places where livestock concentrate directly on or near water sources. These impacts can be magnified on drier grazing allotments where animals tend to congregate around the limited available water resources.

For permitted livestock grazing, as well as the acres of land suitable for livestock grazing, there is no meaningful difference among the alternatives. However, various plan direction that is common to alternatives B, C, and D place an increased emphasis on the health and functionality of various watershed components (e.g., riparian vegetation) As a consequence, impacts to watershed resources from livestock grazing will be greatest under alternative A, and lesser under alternatives B, C, and D.

Effects on Watershed Resources from Fire Management

Watershed studies and post-fire monitoring in snow-dominated hydrologic systems indicate that wildfire has the potential to increase annual water yield similar to timber harvest (Troendle and Bevenger 1996). Additionally, stand-replacing wildfires have the potential to substantially alter both snow accumulation and melt patterns, with melt typically coming earlier and more rapidly, potentially resulting in shifts in both stream peak timing and magnitude. Wildfire can also change, sometimes significantly, the response to short-duration, high-intensity summer thunderstorms, resulting in considerable soil erosion, sediment delivery, flash floods, higher peak flows, and downcutting of stream channels (Carlson 2008). High-severity fire consumes ground cover and alters the soil surface, creating water repellency. The water repellency reduces infiltration rates, resulting in erosion and overland flow to channels. The increased delivery of sediment and streamflow produces debris flows and floods that have the potential to downcut channels and produce floods. Such responses and associated effects, however, are generally seen only for the first 3 to 5 years after a significant high-severity fire due to vegetative recovery and its ability to assimilate thunderstorm intensity, duration, and volume.

Local observations (I. Geroy, U.S. Forest Service Hydrologist) during 2013–2017 of post-fire watershed response to the West Fork Complex Fire indicate that the watershed impacts from high and moderate soil burn severity fires in the spruce-fir forests of the Forest are not as extreme as those observed in fires along the Front Range of Colorado. This can likely be attributed to a multitude of factors, including differences in vegetation type, fire regime condition class, topography, and soils.

In addition to the watershed impacts from the fire itself, fire management activities have the potential to impact watershed resources, primarily through temporary road and fire line construction, which can introduce erosion and sedimentation issues. As a standard practice, resource impacts from fire suppression are mitigated or rehabilitated once it is safe to do so, meaning the watershed impacts from suppression are typically minimal.

Direction for fire management zones does not vary substantially by alternative; as a consequence, impacts to watershed resources from fire management are not expected to vary significantly among alternatives A through D.

Effects on Watershed Resources from Roads and Trails

The construction and maintenance of roads has long been recognized as a potential and major source of sediment in forested watersheds (Megahan and Kidd 1972, Reid and Dunne 1984). Roads can change natural runoff patterns by increasing the amount of impervious surface in a watershed by intercepting overland flow or shallow subsurface runoff, or both. The network of road drainages generally routes this water, and the associated sediment, directly into streams (MacDonald and Stednick 2003). Sediment is the major pollutant associated with roads on public lands. Sedimentation in streams impacts water quality, which can, in turn, impact aquatic life. Sediment can also alter channel morphology, which can subsequently impact aquatic habitat. Road construction and maintenance activities can result in physical changes to streams, including floodplain and riparian habitat modifications, channel degradation, and fish passage reduction.

Poorly designed and maintained road/stream interactions can necessitate increased road stabilization and maintenance costs, and lead to rapid sedimentation and filling in of water storage reservoirs and ponds. Ecological impacts commonly associated with stream/road interactions include aquatic, riparian, and wetland habitat degradation. The watershed impacts associated with trail networks are similar to those associated with roads, but are typically less in magnitude per mile of length. Management actions to reduce motorized cross-country travel and limitations on off-road game retrieval and dispersed camping have the potential to reduce unauthorized roads and trails, which typically have greater impacts than National Forest System roads.

The magnitude of impacts to watershed resources from roads and trails would depend primarily on the number of acres that are designated for uses that would result in expanded road or trail networks. The primary expansion potential for the roads comes from harvest on suitable timber base acres. As a result, alternative C, which has the largest suitable timber base, no recommended wilderness, and minimal roadless management acres would likely have the greatest watershed impacts from roads, trails, and travel management. Conversely, alternative D, which maximizes recommended wilderness, roadless management acres, prohibits off-road game retrieval, and maximizes the number of acres of special designations, would likely have the fewest impacts to watershed resources. Alternatives A and B are likely to have similar impacts to watersheds from roads and trails.

Effects on Watershed Resources from Water Diversions and Water Development Projects

The headwaters of the Rio Grande lie in Colorado’s Water Division 3 and are the main water source for a heavily over-appropriated system. Water diversions have the potential to reduce or eliminate downstream flows, which may, in turn, affect channel size and limit habitat for aquatic and riparian species. Dams alter flow regimes by storing runoff for later release. Dams and diversions can impose substantial barriers to migration of aquatic species and can dewater streams during certain time periods, which can, in turn, fragment aquatic ecosystems. In some cases, altered flow regimes prolong periods of runoff and can enhance riparian vegetation communities. Water wells can reduce the amount of water in connected streams, springs, and seeps, which can have similar impacts to structural water diversions. Dams impact stream channels in different ways, depending on their operation. Reservoirs store sediment and release sediment-free water below the dam. Water storage reduces peak flows, which can reduce the frequency and magnitude of flushing flows. The result can be the reduction of channel capacity, alteration of aquatic habitat, and changes in temperature and other factors that can affect spawning and reproductive success of aquatic species.

In 2000, the Forest Service entered into a settlement in Case No. 81-CW-183 (State of Colorado 2000). The Federal government obtained water rights for administrative, consumptive, and instream purposes as part of this settlement. The decree provides for mean monthly streamflows that encompass both low flow periods and peak spring flows in order to maintain acceptable channel morphology. Due to both the decreed water rights of the Federal government and basin over-appropriation, no new water uses are anticipated on Forest lands during the planning period. As a consequence, the impacts of water uses and developments are unlikely to vary by alternative.

Effects on Watershed Resources from Designation of Wilderness, Wild, Scenic, and Recreational Rivers, Research Natural Areas, Special Interest Areas, and Scenic Trails and Byways

In general, designation of special areas such as wilderness, wild, scenic, and recreational rivers, research natural areas, special interest areas, and scenic trails and byways have the potential to limit the type of activities that result in a large portion of management-related watershed impacts. Particularly, the reduction of suitable timber base due to an increase in the acres of recommended wilderness would result in reduced watershed impacts from timber harvest and road construction/reconstruction. The watershed impacts from the designations such as wild, scenic, and recreational river eligibility, research natural areas, and special interest areas would vary based on the reason or purpose of the designation, but they are not expected to exceed the impacts that would potentially occur under alternative A. As a consequence, the nature and magnitude of impacts to watershed resources under alternatives A and C would be similar, and would be greater than the expected impacts of alternative B. Alternative D would provide the lowest level of watershed resource impacts, primarily due to the large number of acres of recommended wilderness.

Effects on Watershed Resources from Mineral Resource Activities

Mining activities conducted may include gravel operations, landscape rock, and hard-rock mining. New mining operations for locatable minerals are expected to be small and limited in quantity; however, to a certain extent, this cannot be predicted. Federal authority over mining activities allows for the setting of terms and conditions in operating plans to minimize impacts to public lands; however, mining activities can be expected to impact both watershed health and water quality.

Due to the variability and uncertainty in mineral extraction there is not expected to be a meaningful difference in impacts to watershed resources from mineral extraction under alternatives A though D.

Effects on Watershed Resources from Climate Variability

Over the past several decades, the mountains of southwest Colorado have seen reductions in peak snowpack and substantial shifts in the timing of snowmelt and snowmelt runoff toward earlier in the year (Clow 2010, Harpold et al. 2012). These trends are expected to continue or potentially accelerate in the future with rising temperatures and increasing variability of precipitation inputs (Lute et al. 2015, Scalzitti et al. 2016). Alterations in the timing and magnitude of stream discharges have the potential to generate a wide variety of watershed impacts. Increased peak discharges have the potential to alter and damage stream channels and streamside vegetation. Reduced late-season flows and increased air temperatures could reduce the spatial extent and health of riparian and wetland vegetation, further impacting streambank stability and the ability of watersheds to sustain base flow. Increases in air temperatures and reductions in late-season flows will likely result in increased stream temperatures and have the potential to increase the concentration of various contaminants and alter the cycling of sediment and nutrients. Additionally, most streams in the headwaters of the Rio Grande are anticipated to see reductions in total annual discharge, which will affect both the human and natural environment through decreased water availability during the growing season.

Climate variability is the same across all alternatives; however, alternatives that limit disturbances or focus protection on key watershed components such as wetlands and riparian vegetation will most successfully function under a variety of climate scenarios. As a consequence, alternative D is likely to realize fewer impacts associated with climate change to watershed resources, followed by alternatives B, C, and A.

Cumulative Effects

Cumulative effects were considered for the implementation period of the forest plan revision, from the watershed boundary of the Forest down to the New Mexico-Colorado border. Watershed cumulative effects include the total impacts of runoff, erosion, sediment or water yield, and water quality that result from the incremental impact of the alternatives when added to other past, present, and reasonably foreseeable future actions occurring in the same natural drainage basin or watershed.

The most pertinent past and current effects that need to be considered are the impacts from the management of livestock grazing, timber harvest, and travel management. Reasonably foreseeable future actions included in this analysis are widespread salvage projects that are in various stages of planning across the Forest, and potential village development at Wolf Creek Pass.

Widespread salvage projects would primarily occur on lands that were identified as suitable timber base under all alternatives; as a consequence, the programmatic impacts of these projects was accounted for in the analysis of impacts from harvest on suitable timber base, and do not provide additive cumulative effects.

When combined with the past, present, and reasonably foreseeable future actions, the effects discussed above do not combine to create significantly larger cumulative impacts to watershed resources. As a consequence, total cumulative impacts mirror the indirect effects, with the impacts from alternatives A and C being similar in nature and magnitude, while the impacts from alternative B would be lesser in magnitude. Alternative D would have the fewest watershed resource impacts.

Riparian, Wetlands, and Fens

Overview

In the arid and semiarid landscape of the southwestern United States, areas that retain moisture and associated vegetation types have long been recognized as important for both ecosystem function and human benefits. The presence of riparian areas, wetlands, and fens across the Forest provide key ecosystem services that are necessary for the long-term health and well-being of both aquatic and upland areas.

Riparian areas and wetlands provide numerous ecosystem services that are vital to the role of the Forest as a supplier of water to downstream users. These services include stabilizing streambanks and reducing erosion, mitigating the impacts of floods, improving water quality through trapping sediment and other pollutants, and sustaining late season base flows. In addition to providing multiple benefits to water users, riparian and wetland ecosystems are vital to a wide variety of flora and fauna. Both aquatic and terrestrial wildlife species depend on the forage and cover provided by these habitat types, and many rare plant species exist only within the confines of riparian and wetland ecosystems. Finally, these ecosystems serve as a focal point for recreation across the Forest, with visitors consistently choosing to camp and recreate near the water sources that both sustain, and are sustained by, riparian and wetland ecosystems.

Affected Environment, Existing Conditions, and Trends

Riparian and wetland ecosystems across the arid West have long been recognized as unique areas that have high levels of productivity and host a disproportionate number of plant and animal species. Due to the relative abundance of water, these same areas have long been a focus of human development and recreation. Based on digitized national wetland inventory mapping, there are 42,862 acres of wetlands and water bodies within the Forest, of which lakes and rivers comprise 4,687 acres or 11 percent. This estimate for wetlands and water bodies represents about 2 percent of the total area in the Forest. Slightly more than half, 55 percent, of the national wetland inventory mapped acres are freshwater herbaceous wetlands. Shrub wetlands make up another 30 percent. When broken down by hydrologic regime, saturated wetlands, which are the most common, comprise 73 percent of national wetland inventory acres. Within the Forest, 82 percent of all lakes are mapped with a dammed/impounded modifier, indicating that most lakes are reservoirs of one kind or another. Beavers influence only 4 percent of all wetland acres, but 23 percent of ponds are mapped as beaver ponds and 6 percent of shrub wetlands are mapped with beaver influence. Sixty-five percent of all national wetland inventory acres occur in the subalpine ecoregions, which make up roughly the same proportion of the Forest’s land area. Another 29 percent of national wetland inventory acres occurs in the alpine zone. Lower-elevation zones contain very few wetland acres.

Riparian areas are the important ecosystems along streams, lakes, and other water bodies. Riparian areas are actually three-dimensional: they 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. There are approximately 130,000 acres of riparian areas, or 7 percent of the Forest, associated with more than 11,000 miles of streams and other wetland areas.

Plants in a riparian area, like willows and sedges, depend on the water source. This distinct water-loving vegetation makes most riparian areas easy to recognize. Riparian areas are home to a greater variety of aquatic and terrestrial wildlife than any other habitat type across the landscape. Riparian areas are also important in maintaining water quality and streamflow by capturing sediment, trapping organic matter, and regulating flooding.

The montane fen ecological system includes extreme rich fens and iron fens, both rare in the southern Rocky Mountains ecoregion. Since this system relies on groundwater, any disturbances that impact water quality or quantity are a threat. Fens, wetlands, seeps, and springs are central to ecosystem resilience in light of uncertainties such as climate change. Preliminary evaluations indicate that about 73 percent of wetland acres on the Forest are saturated hydrologic regimes, which likely consist in large part of fens.

At the 6th level watershed scale, riparian and wetland areas have been rated primarily as fair (50 percent) or good (39 percent), with only 11 percent, or 16 watersheds, receiving a rating of poor during the watershed condition framework assessment (Assessment 2, Table 27) (USDA Forest Service 2016). Factors that influenced the riparian and wetlands ratings include uncontrolled motorized recreation, historical and current livestock grazing in both uplands and riparian areas/wetlands, lack of road and trail maintenance, and introduction of exotic and invasive aquatic and terrestrial species.

Between 2008 and 2011, the Colorado Natural Heritage Program partnered with Colorado Parks and Wildlife to map and assess the condition of wetlands throughout the Rio Grande headwaters river basin, which includes the Forest.

In total, 77 wetland sites were surveyed across the Forest, including 30 riparian shrublands, 27 wet meadows, 17 fens, 2 riparian woodlands, and 1 marsh. Nearly 500 plant taxa were encountered during the surveys, including 445 identified to species level. Of the 445 species identified, 420 (94 percent) were native species and 25 (6 percent) were nonnative species. Noxious weeds, an aggressive subset of nonnatives, were present in only four plots.

Wetland condition measures indicate that wetlands on the Forest are in excellent to good condition. Floristic quality assessment indices were high for most wetlands surveyed, though did vary by both elevation and wetland type. Ecological integrity assessment scores rated most wetlands with an A- or B-rank, indicating that wetlands were either in reference condition or deviated only slightly from reference condition. A handful of wetlands received C-ranks, due to stressors including grazing, hydrologic modifications, and surrounding land use.

Direct and Indirect Effects

A summary impacts analysis for riparian and wetland ecosystems would rely primarily on an assessment of which management activities have the greatest ability to impact these areas, and which alternatives propose the greatest numbers of acres that are available to those management activities.

It can be reasonably anticipated that the greatest future impacts to these ecosystems would come from those management activities that are known to have resulted in impacts during previous planning periods, namely: system roads and trails, uncontrolled motorized use on unauthorized roads and trails, and livestock grazing (Assessment 2).

Alternatives A through D essentially represent varying partitions of acreage among a variety of potential uses, ranging from restrictive management prescriptions (e.g., wilderness) to general forest areas that are suitable for harvest, grazing, and dispersed/motorized recreation. Among all alternatives the acreage of suitable rangeland remain nearly constant with the exception of small alterations based on special area designations. As a result, livestock grazing impacts to riparian and wetland ecosystems are expected to remain consistent with those observed in the previous planning period, and will not vary significantly by alternative.

Among the action alternatives, alternative D represents a minimization of acreages that would be available for expansion of the road/trail network, particularly for motorized vehicles and timber harvest. As a result, alternative D would likely have the fewest impacts on riparian and wetland ecosystems. Alternatively, C represents a maximum number of acres available for the potential expansion of the motorized trail network, and the maximum number of acres suitable for timber harvest and the necessary access roads. Consequently, alternative C would likely have the greatest impacts to riparian and wetland ecosystems. The impacts of alternative A would likely be similar in magnitude to those of alternative C, even with a reduced suitable timber base, due to the lack of designated areas and recommended wilderness. The potential watershed impacts in order of magnitude would range from alternative D at the low end, to alternative B, followed by alternatives A and C at the high end.

Effects on Riparian, Wetlands, and Fens from Vegetation Management

Vegetation management and timber harvest within riparian and wetland ecosystems is generally prohibited or constrained sufficiently such that these activities do not remove riparian vegetation or cause direct manipulation of wetlands. The primary exception to this practice is the placement and construction of roads necessary to complete timber harvest and vegetation management activities. Roads directly alter riparian vegetation when, by necessity, they cross the riparian corridors associated with streams. These alterations come by means of both riparian vegetation removal at the site of the stream crossing, and via alteration of surface and subsurface flow patterns, which can subsequently alter riparian vegetation communities. Roads are not permitted in wetland ecosystems, but do have the potential to alter surface and subsurface flow patterns in the vicinity of these areas. Other impacts from timber harvest include the alteration of the hydrologic cycle in the immediate vicinity of the harvest, which may modify the timing and magnitude of runoff, and change the amount of water available to riparian and wetland areas.

The impacts on riparian and wetland ecosystems from timber harvest and vegetation management would vary based primarily on the number of acres found to be part of the suitable timber base. Acres of suitable timber base vary substantially by alternative, with all action alternatives representing a substantial increase over alternative A. Based on suitable timber acreage and management direction, alternative C would be expected to have the greatest impacts to riparian and wetland areas, followed by alternatives A, B, and D, respectively.

Effects on Riparian, Wetlands, and Fens from Livestock Grazing

Improper grazing practices can impact riparian area and wetland ecosystems through several mechanisms. Grazing impacts such as trailing along and through riparian and wetland areas, long seasons of use, and poor timing of livestock grazing can result in long recovery times, soil compaction, pugging, hummocking, soil sloughing, and changes in desirable vegetation species composition. In addition, unmanaged livestock grazing can crush and uproot plants due to trampling. Overgrazing and excessive seasons of use can decrease plant vigor and root reserves, which could result in plant mortality and loss of ground cover. Resulting bare soil could in turn reduce infiltration and increase runoff, impacts that subsequently lead to problems with physical channel stability that can further damage riparian plants via stream channel downcutting and altered patterns of sediment production and deposition. For these reasons, unmanaged livestock grazing impacts could decrease the abundance and distribution of desirable native plants and change the composition, structure, and function of the affected riparian area and wetland ecosystems. In particular, native willows are often selectively and excessively browsed by cattle and frequently sustain impacts when unmanaged livestock grazing practices occur over time.

The impacts described above are typically avoided through proper rangeland management, which entails the application of the standards, guidelines, and management approaches detailed in this forest plan revision, along with a variety of other tools. Periodic monitoring and assessment of conditions can drive changes in management practices to remedy undesirable conditions. For permitted livestock grazing, as well as the acres of land suitable for livestock grazing, there is no meaningful difference among the alternatives. However, various plan components that are common to alternatives B, C, and D place an increased emphasis on the health and functionality of riparian vegetation, wetlands, and fens. As a consequence impacts to watershed resources from livestock grazing would be greatest under alternative A, and less under alternatives B, C, and D.

Effects on Riparian, Wetlands, and Fens from Recreation

Riparian and wetland areas typically attract recreation activities such motorized travel, camping, hiking, mountain biking, and horseback riding. If not properly managed, these activities have the potential to impact riparian areas and wetland ecosystems by physically removing vegetation, or crushing or displacing shrubs and herbs, which results in mortality to plants and the loss of canopy and ground cover. If recreational activities (particularly motorized) occur in riparian or wetland areas when soils are saturated, severe rutting typically occurs, which can lead to erosion and loss of native riparian and wetland ecosystem vegetation. Recreational activities also have the potential to introduce and spread terrestrial and aquatic invasive exotic plants that compete with native plants for space, water, and nutrients. The extent of these impacts depend in large part on the vegetation type, plant growth form (graminoids are more resistant to damage compared to trees, shrubs, and forbs), slope, soil type, season, and weather conditions (Hill and Pickering 2009). Impacts to riparian area and wetland ecosystems from unmanaged recreational activities would be similar for all the alternatives.

Alternatives that place an emphasis on nonmotorized forms of recreation are most likely to avoid negative impacts to riparian and wetland ecosystems. As a consequence, alternative D would likely have the fewest recreational impacts to riparian and wetland resources, followed by alternative B, then A and C.

Effects on Riparian, Wetlands, and Fens from Water Diversions and Water Development Projects

Water diversions and developments have a wide variety of impacts on riparian and wetland ecosystems. The reduction of available water has the potential to reduce the spatial extent and persistence of these areas, limit nutrient availability, and alter the species composition to favor those plants that are more resistant to water shortage. In other cases, sustained flow through late season releases from reservoirs has the ability to enhance the health of riparian and wetland ecosystems. The existing riparian vegetation within the planning area has persisted through substantial flow modifications for more than the last 100 years in the Rio Grande Basin.

In 2000, the Forest Service entered into a settlement in Case No. 81-CW-183 (State of Colorado 2000). The Federal government obtained water rights for administrative, consumptive, and instream purposes as part of this settlement. The decree provides for mean monthly streamflows that encompass both low flow periods and peak spring flows to sustain a variety of ecosystem functions, including riparian vegetation. Due to both the decreed water rights of the Federal government and basin over-appropriation, no new water uses are anticipated on Forest lands during the planning period. As a consequence, the impacts of water uses and developments on riparian and wetland ecosystems are not expected to vary by alternative.

Effects on Riparian, Wetlands, and Fens from Designation of Wilderness, Wild, Scenic, and Recreational Rivers, Research Natural Areas, Special Interest Areas, and Scenic Trails and Byways

The designation of special areas such as wilderness, wild, scenic and recreational rivers, research natural areas, special interest areas, and scenic trails and byways have the potential to limit the type of activities that frequently impact riparian and wetlands ecosystems. Particularly, the reduction of suitable timber base due to an increase in the acres of recommended wilderness would result in reduced impacts to riparian and wetland ecosystems. This results from decreases in timber activity that could potentially alter the hydrology of these ecosystems, and decreased road construction activities that typically directly impact riparian areas. Impacts to riparian and wetland ecosystems from designations such as wild, scenic, and recreational river eligibility, research natural areas, and special interest areas will vary based on the reason or purpose of the designation, but in general would likely protect or enhance riparian and wetland areas.

As a consequence, the nature and magnitude of impacts to riparian and wetland ecosystems under alternatives A and C would be similar, and would be greater than the expected impacts of alternative B. Alternative D would provide the lowest level of impacts to these systems primarily due to the large number of acres recommended wilderness.

Effects on Riparian, Wetlands, and Fens from Mineral Resource Activities

Mining activities conducted in the planning area may include gravel operations, landscape rock mining, and hard-rock mining. New mining operations for locatable minerals are expected to be small and limited in quantity; however, to a certain extent, this cannot be predicted. Federal authority over mining activities allows for the setting of terms and conditions in operating plans in order to minimize impacts to public lands; however, mining activities have substantial ability to impact riparian and wetland ecosystems through both the physical removal of vegetation and alteration of the hydrologic regime.

Due to the variability and uncertainty in mineral extraction, there is not expected to be a meaningful difference in impacts to riparian and wetland ecosystems from mineral extraction under alternatives A though D.

Effects on Riparian, Wetlands, and Fens from Climate Variability

Over the past several decades the mountains of southwest Colorado have seen reductions in peak snowpack and substantial shifts in the timing of snowmelt and snowmelt runoff toward earlier in the year (Clow 2010, Harpold et al. 2012). These trends are expected to continue or potentially accelerate in the future with rising temperatures and increasing variability of precipitation inputs (Lute et al. 2015, Scalzitti et al. 2016). Increased air temperatures, extreme high-flow and low-flow events, alterations to groundwater recharge patterns, and changes in various sediment and nutrient cycles all have the potential to impact riparian and wetland ecosystems. Reductions in base flows, particularly in late summer when elevated temperatures increase evapotranspiration, have the ability to alter the species composition and spatial extent of riparian areas. Because climatic variables influence hydrologic processes, any change in precipitation, evapotranspiration, snow accumulation, or snowmelt will influence recharge to groundwater systems. Future climate change will affect recharge rates and, in turn, groundwater levels and the amount of groundwater available to support springs and wetlands (Ludwig and Moench 2009). Reduction of groundwater tables could alter both species composition and the spatial extent of these features across the landscape.

Climate variability is the same across all alternatives; however, alternatives that limit disturbances to riparian and wetland ecosystems would provide the best opportunity for these areas to persist and maintain functionality into the future. As a consequence, alternative D is likely to realize fewer climate change-associated impacts to riparian and wetland ecosystems, followed by B, C, and A.

Cumulative Effects

Cumulative effects were considered for the implementation period of the forest plan revision, from the watershed boundary of the Forest down to the state line with New Mexico. Cumulative effects include the total impacts to riparian and wetland ecosystems from the destruction of vegetative cover and altered hydrology, and results from the incremental impact of the alternatives when added to other past, present, and reasonably foreseeable future actions occurring within the same natural drainage basin or watershed.

The most pertinent past and current effects that need to be considered for this analysis are the impacts from the management of livestock grazing, timber harvest, and travel management. Reasonably foreseeable future actions included in this analysis are: widespread salvage projects that are in various stages of planning across the Forest, potential village development at Wolf Creek Pass, and the implementation of the San Luis Valley Regional Habitat Conservation Plan, which involves the maintenance and improvement of riparian and wetland habitats on private land across the San Luis Valley, many of which are immediately adjacent to Forest lands.

Programmatic impacts of salvage projects would occur on lands that were identified as suitable timber base under all alternatives; therefore, the projects are accounted for in the analysis of impacts from harvest.

When combined with the past, present and reasonably foreseeable future actions, the indirect effects discussed above do not combine to create significantly larger cumulative impacts to riparian and wetland resources. As a consequence, total cumulative impacts mirror the indirect effects, with the impacts from alternatives A and C being similar in nature and magnitude, while the impacts from alternative B would be lesser in magnitude. Alternative D would have the fewest impacts to riparian and wetland ecosystems.

Wildlife and Plant Species

Overview

The Rio Grande National Forest surrounds the San Luis Valley and supports a variety of habitat types that extend from the foothill zone at about 7,800 feet in elevation to a high of 14,345 feet in the alpine zone. Eleven different habitat types associated with the Southern Rockies Physiographic Region support the vast majority of the approximately 260 species of vertebrate wildlife that occur on the Forest. However, the Forest is unique in that it also interfaces with the Central Shortgrass Prairie Region that extends north from New Mexico and encompasses much of the floor of the San Luis Valley. This intermix of physiographic regions supports some plains and grassland species that may reside in select locations on the Forest and/or occur as peripheral populations. The fact that about 50 percent of the Forest occurs as wilderness and/or backcountry designations contributes to the unique remote character and solitude habitat conditions that some rare or large-ranging species prefer.

Wetlands and water bodies comprise aquatic habitats that occupy 42,862 acres, or about 2.3 percent of the total land area, on the Forest. The water bodies are represented by about 2,000 miles of rivers and streams highlighted by the headwaters of the third-largest river in the United States—the Rio Grande. Two other major tributaries are the Conejos and Alamosa Rivers. The water bodies are also represented by hundreds of high mountain lakes, reservoirs, and ponds that, along with rivers and streams, account for 4,687 acres or 11 percent of the total. These aquatic habitats contribute significantly to the diversity of species that occur across the landscape. Maps showing *Wetlands and Known Fens for Alternatives A through D* are contained on the DVD located at back of this document.

The Forest has 253 known vertebrate species: 172 bird species, 62 mammal species, 9 reptiles and amphibians, and 11 fish species (4 native, 7 introduced); it is likely that additional species on the Forest have not yet been documented. There are about 1,800 plant species Forestwide. There is no compiled source available from which to estimate the number of invertebrate animal species present.

The Forest also has a number of existing special interest areas and research natural areas that support wildlife and plant species. For information on these special designated areas, see the *Forested Ecosystems – Rare Communities and Special Habitats* and the *Proposed Special Interest Areas and Research Natural Areas* sections.

At-Risk Species

In developing a forest plan revision, the 2012 Planning Rule requires the Forest Service to assess the at-risk species on the Forest. The purpose of identifying at-risk species is to help develop forest plans that maintain the diversity of plant and animal communities and provide for the persistence of native species in the plan area. Most species are expected to be maintained by plan components (desired conditions, objectives, standards, guidelines, and suitability of lands) that provide for broad ecosystem integrity and ecosystem diversity.

Some species that are not adequately assessed using the coarse-filter approach may require additional species-specific plan components, particularly to help in recovering federally recognized species or where it may not be possible to maintain a viable population of some at-risk species within the plan area. This need may also be associated with circumstances beyond the authority of the Forest Service or due to limitation in the inherent capability of the land. Examples include local species such as boreal toad, Rocky Mountain bighorn sheep, and several avian and bat species. In some cases, such as bats or Rocky Mountain bighorn sheep, the primary conservation need involves potential anthropogenic influences such as disease transmission. As defined by the 2012 Planning Rule, at-risk species include:

i. Federally recognized threatened, endangered, proposed, and candidate species (FSH 1909.12_10 sec. 12.51).

ii. Potential species of conservation concern (FSH 1909.12_10 sec. 12.52).

The planning rule further defines species of conservation concern:

> *"A species of conservation concern is 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-tern in the plan area."*

Based on that information, Forest staff identified and documented a draft set of at-risk species and assessed plan area ecological conditions for these species. For this assessment, the direction followed is outlined in Forest Service Handbook (FSH) 1909.12 Land Management Planning Handbook, Chapter 10 – The Assessment; Section 12.5 – Identifying and Assessing At-risk Species.

Analysis and Methods

This analysis evaluates the effectiveness of the alternatives to provide direction to create the ecological conditions to contribute to the recovery of federally listed threatened and endangered species, conserve proposed and candidate species, maintain a viable population of species of conservation concern, and allow for sufficient numbers of demand species within the plan areas.

The primary emphasis areas involved with plan considerations of wildlife and plant species include:

1. The maintenance and restoration of ecological integrity of terrestrial and aquatic ecosystems. This addresses the need to maintain or restore habitat structure, function, composition, and connectivity.
2. Provide for the diversity of plant and animal communities.
3. Provide for species-specific ecological conditions within the plan area for conservation, recovery, and viability needs, when coarse filter applications do not provide for the required protections of these species.
4. Provide for ecosystem uses and multiple uses, including fish and wildlife species.

The 2012 Planning Rule uses a complementary ecosystem (coarse filter) and species-specific (fine filter) approach to assess the potential of the alternatives for providing the habitat characteristics to support wildlife diversity and the persistence of native species in the plan area. The coarse filter approach assumes that wildlife diversity is broadly dependent upon the integrity of the function, composition, and structure of the Forest's terrestrial, riparian, and aquatic ecosystems. This analysis compares the current abundance and condition of various habitats with ecological reference conditions (natural range of variation) based on the dynamic nature of ecosystems, recognizing they are not static (Landres et al. 1999). It recognizes that disturbances or processes (such as fire, flooding, insects, and disease) and responses to those are part of natural ecosystem processes. However, because integrity of whole ecosystems does not necessarily address all species' needs, additional fine-filter (species-specific) analyses were conducted to ensure that persistence is provided for at-risk wildlife species.

Disruption of natural processes (such as fire suppression) can impact diversity and lead to a departure from the natural range of variation. Maintaining or mimicking natural processes and naturally occurring structural diversity; promoting natural patterns and connectivity; restoring ecosystems, communities, and species; and protecting the ecological characteristics required by at-risk species are all means to maintain biodiversity in an ecosystem. The coarse-filter and fine-filter approaches used in this analysis help to disclose how well each alternative addresses these needs.

Overall, a qualitative approach based on scientific literature, local knowledge, and data sources about species, their habitat, and effects of management was used for this analysis. The analysis of habitat is based largely on that described in the *Terrestrial Ecosystems* and *Aquatic and Riparian Ecosystems* sections (coarse filter components, described in Assessments 1, 2, and 3) (USDA Forest Service 2016). The evaluation of environmental consequences to habitat that supports species persistence is framed as a risk assessment in terms of alternative effectiveness. However, there is a level of uncertainty about the possible effects of forest management and activities on habitat that supports species persistence because of gaps in knowledge about the complex interaction between species and their habitats and how some species respond to varying degrees of habitat alteration.

Information and science-based recommendations for federally listed species under the Endangered Species Act are included in species recovery plans, biological opinions, and critical habitat designations. This information was considered in developing plan components that are designed to provide, as appropriate, ecological conditions in the plan area necessary to meet the requirements for each at-risk species, grouping, or ecosystem.

Indicators and Measures

The key indicators for the analysis are trends in habitat quantity and habitat condition measured at a landscape scale. Primary habitat associations and associated threats are described for each at-risk species. Habitat in this context includes not just the general vegetation types used by wildlife or described in classification systems, but also the key components needed for the recovery, conservation, and viability of the plant and animal species, especially at-risk species.

- **Habitat quantity** is measured by the potential trend in amount and distribution of habitat types in the plan areas over the next 15 to 20 years. Quantity has the theoretical potential to be measured at both the broadscale level and the fine-scale conditions as defined in the select set of ecological conditions associated with each species of a group of species. The Forest Service currently lacks detailed enough spatial data to map most of the fine-scale habitat areas.
- **Habitat quality** is measured by relative condition of the ecological characteristics that comprise functional habitat for a particular species or group of species. This includes trends in habitat capability such as departure from the natural range of variability and the ability of habitats to be adaptable and remain functional in the event of large-scale disturbances (such as wildfire, insect outbreaks, and drought).
- **Habitat connectivity** is measured by physical attributes that might provide barriers to effective movement such as roads, trails, and developments, and by changes in vegetative or habitat structural conditions that influence the ability of species to move across the landscape. The degree to which physical features interrupt connectivity varies depending on the size/width of the feature, and the type and frequency of use it receives. Habitat connectivity can also be influenced by landscape patterns associated with vegetative structural conditions, and changes in these conditions due to natural succession, natural disturbance processes, and management activities. Potential impacts from impaired connectivity can vary from one species to the next depending upon the characteristics of each species.

These indicators were selected because they provide a reasonable assessment of ecological conditions needed to contribute to the recovery of federally listed threatened and endangered species, conserve proposed and candidate species, and maintain a viable population of each species of conservation concern in the plan area.

Management direction that may alleviate or exacerbate threats to habitat are evaluated at a programmatic level. The proposed forest plans do not authorize site-specific projects or activities; therefore, there are no direct effects from adopting these forest plans. The direct and indirect site-specific effects will be analyzed when projects are proposed. Although potential short-term effects may be described where appropriate, this evaluation focused on longer term (15 to 20 years) indirect effects.

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 (Wiens et al. 2012). The natural range of variation was used in development of plan direction (desired conditions) and the selection of indicators and measures for the analysis because the quality and quantity of habitat available to a species helps predict the potential for species distribution and abundance within that habitat. Also important in the analysis of ecological integrity and sustainability of vegetation are consideration of climate and associated fire trends that may be creating a combination of conditions that are outside the natural range of variation (Safford et al. 2012, 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, including at-risk species. 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 where possible.

The analysis involves:

- identifying habitat associations of and threats to at-risk species,
- reviewing plan components that have potential to influence habitat conditions, thereby influencing the ecological conditions that would support species persistence,
- evaluating the proposed magnitude of change in the management approach by alternative and potential consequences from the management approach, and
- revising plan components (including incorporating fine-filter components where necessary) to provide needed ecological conditions.

For each at-risk species federally listed, candidate, or proposed for listing, determinations indicate whether alternatives (1) maintain or restore habitats in the plan area to provide the ecological conditions necessary to contribute to recovery of threatened and endangered species, and (2) contribute to preventing proposed and candidate species from becoming federally listed in the future. As described above, the extent and condition of habitat were the indicators used to determine if such ecological conditions were present to conserve species and to contribute to preventing species from becoming listed. The analysis also considers the authority of the Forest Service and the inherent capability of the plan area to provide for federally listed at-risk species.

When developing plan components (ecosystem and species-specific) to conserve at-risk threatened, endangered, candidate, and proposed species, we:

1. Considered conservation measures identified in existing conservation strategies and agreements relevant to proposed and candidate species in the plan area.

2. Considered limiting factors and key threats to species identified in proposed rules from the U.S. Fish and Wildlife Service for listing, candidate species assessments, or accepted petitions.
3. Consulted with (and will continue to consult with) the U.S. Fish and Wildlife Service in the evaluation of existing conditions for proposed and candidate species and in the evaluation of plan components designed to conserve the species.
4. Considered collaboration and cooperation beyond the plan area boundary with the U.S. Fish and Wildlife Service, states, tribes, other partners, landowners, and land managers to support an all-lands approach to conserve proposed and candidate species.

Sources of information include:

- Peer-reviewed published literature, general technical reports, and other reports by the Forest Service and other agencies,
- Various databases such as NatureServe Explorer (2017), Colorado Natural Heritage Program (2017), Intermountain Region Herbarium Network (2016), Bird Conservancy of the Rockies(2017), Xerces Society for Invertebrate Conservation (2017), Forest Service Natural Resource Information System Wildlife database, and eBird (2017a) hotspots and eBird (2017b) occurrence records,
- Personal communications with researchers, species experts, and Colorado Parks and Wildlife staff,
- U.S. Fish and Wildlife Service recovery plans for threatened and endangered species,
- The Rio Grande National Forest assessments (USDA Forest Service 2016),
- The Southern Rockies Lynx Amendment (USDA Forest Service 2008),
- Resource reports for terrestrial ecology, fire ecology, and aquatic ecosystems, and
- Species overviews from the development of Assessment 5 (USDA Forest Service 2017a, USDA Forest Service 2017b).

Analysis Area

In general, the analysis area for indirect effects includes all lands managed by the Forest; however, for the purposes of this document it may include areas outside the Forest boundaries. In some cases Forest lands may provide all or a high percentage of the habitat for a given species; however, in most instances, wildlife generally moves from area to area and habitats on Forest lands may be important to a species' survival. Cumulative effects analyses generally include lands within other ownerships immediately adjacent to the Forest.

For some wide-ranging species, the analysis area was adjusted to better consider home range size and included an evaluation of connectivity between larger areas of habitat. For species with migratory or travel routes that extend far beyond the planning area, management direction would only influence habitat persistence (both quantity and condition) within the forest plan areas, but actions that occur outside of Forest lands is beyond the authority of the Forest Service to influence.

Assumptions

- If a species is associated with a particular habitat, then the condition, amount, and distribution of those habitat elements available to the species on the landscape help to predict its distribution and abundance within that habitat.
- Habitat abundance and distribution similar to that which supported associated species during conditions as a consequence of evolutionary time will likely contribute to their maintenance in the future (Haufler 1999). Therefore, habitat abundance, distribution, and condition similar to that within the natural range of variation for the habitats will likely contribute to species maintenance in the future. (See also the *Terrestrial Vegetation Ecology* section).
- In general, the further a habitat is departed from desired conditions (natural range of variation), the greater the risk to viability of associated species. Conversely, the closer a habitat is to desired conditions, the lower the risk to viability of associated species Therefore, comparing the degree to which the alternatives maintain and trend conditions toward desired conditions provides a comparison of each alternative's viability effectiveness.

Species Evaluated

The following tables list the names of federally listed species and species of conservation concern that were considered in this analysis. None of the federally listed species currently have any listed or proposed critical habitat on the Forest. The southwest end of proposed critical habitat for the yellow-billed cuckoo (Unit 60, CO-7) is adjacent to, but does not occur on, the Forest. Federally listed species identified for analysis are listed in Table 46. Species identified in Assessment 5 as species of conservation concern are listed in Table 47 (invertebrates), Table 48 (amphibians), Table 49 (fish), Table 50 (birds), Table 51 (mammals), and Table 52 (plants). There are no threatened, endangered, proposed, or candidate fish species on the Forest.

Federally Listed Wildlife Species

Table 46. Federally recognized species on or potentially affected by the Forest

Scientific Name	Common Name	Status
Boloria acrocnema	Uncompahgre fritillary butterfly	Endangered
Centrocercus minimus	Gunnison sage-grouse	Threatened
Coccyzus americanus	Yellow-billed cuckoo	Threatened
Empidonax traillii extimus	Southwestern willow flycatcher	Endangered
Gulo gulo	Wolverine	Proposed threatened
Lynx canadensis	Canada lynx	Threatened
Mustela nigripes	Black-footed ferret	Endangered Nearby population is experimental, nonessential
Strix occidentalis lucida	Mexican spotted owl	Threatened
Zapus hudsonius luteus	New Mexico meadow jumping mouse	Endangered

Species of Conservation Concern

Table 47. Invertebrate species of conservation concern

Scientific Name	Common Name
Bombus occidentalis	Western bumblebee
Oeneis bore	White-veined arctic butterfly

Table 48. Amphibian species of conservation concern

Scientific Name	Common Name
Anaxyrus boreas	Boreal toad

Table 49. Fish species of conservation concern

Scientific Name	Common Name
Catostomus plebeius	Rio Grande sucker
Gila pandora	Rio Grande chub
Oncorhynchus clarkii virginalis	Rio Grande cutthroat trout

Table 50. Bird species of conservation concern

Scientific Name	Common Name
Accipiter gentilis	Northern goshawk
Aegolius funereus	Boreal owl
Falco peregrinus anatum	Peregrine falcon
Lagopus leucura altipetens	Southern white-tailed ptarmigan
Otus flammeolus	Flammulated owl
Spizella breweri	Brewer’s sparrow

Table 51. Mammal species of conservation concern

Scientific Name	Common Name
Corynorhinus townsendii townsendii	Townsend’s big-eared bat
Cynomys gunnisoni	Gunnison’s prairie dog
Lontra canadensis	River otter
Martes americana	American marten
Myotis thysanodes	Fringed myotis
Perognathus flavescens	Plains pocket mouse
Thomomys talpoides agrestis	Northern pocket gopher

Table 52. Plant species of conservation concern

Scientific Name	Common Name
Aliciella penstemonoides	Black Canyon gilia
Aliciella sedifolia	Stonecrop gilia
Alsinanthe macrantha	Houses Stitchwort
Astragalus brandegeei	Brandegee milkvetch
Astragalus ripleyi	Ripley's milkvetch
Botrychium pinnatum	Northern moonwort
Botrychium simplex	Little grapefern/least moonwort
Carex limosa	Mud sedge
Castilleja puberula	Shortflower Indian paintbrush
Crepis nana	Dwarf alpine hawksbeard
Cryptantha weberi	Weber's catseye
Cryptogramma stelleri	Slender cliffbreak
Cystopteris montana	Mountain bladderfern
Delphinium alpestre	Wahatoya Creek larkspur
Draba graminea	Rocky Mountain draba/San Juan whitlow-grass
Draba grayana	Gray's draba
Draba smithii	Smith's draba/Smith's whitlow-grass
Draba streptobrachia	Alpine tundra draba/Colorado divide whitlow-grass
Erigeron philadelphicus	Philadelphia fleabane/Philadelphia daisy
Ipomopsis multiflora	Many-flowered ipomopsis/Many-flowered gilia
Isoetes tenella	Spiny-spore quillwort
Luzula subcapitata	Colorado woodrush
Machaeranthera coloradoensis	Colorado tansy aster
Oxytropis parryi	Parry's oxytrope/Parry's crazy-weed
Potentilla ambigens	Silkyleaf cinquefoil/Southern Rocky Mountain cinquefoil
Salix arizonica	Arizona willow
Saxifraga caespitosa ssp. *monticola*	Tufted alpine saxifrage
Silene kingii	King's campion
Sphagnum angustifolium	Sphagnum bog-moss
Townsendia rothrockii	Rothrock's Townsend daisy
Woodsia neomexicana	New Mexico cliff fern
Woodsia plummerae	Plummer's cliff fern

Legal and Administrative Framework

Prior to issuing a decision, the Forest Service will formally consult with the U.S. Fish and Wildlife Service and request a biological opinion regarding the selected alternative and proposed forest plans. During the consultation process, the U.S. Fish and Wildlife Service may provide additional information that may lead to refined plan components to better conserve habitats and contribute to the recovery of listed species. Where appropriate to a programmatic forest plan, some consultation direction will be incorporated. Some, but not all, of this direction will be applied as coarse- or fine-filter plan components, though there may be other direction that could be better suited to apply at the project level since conditions can vary widely. Forest plans are intended to be adaptive, and changes can be made for newly listed species, for new critical habitat designations, or as new information becomes available. Once approved, consultation will be reinitiated on the forest plans, as needed. Consultation obligations will still apply to site-specific Forest Service actions independent of the forest plan, as required by the Endangered Species Act and Agency procedures.

Affected Environment

Ecosystems and conditions of the Forest are described in detail in the *Forested and Nonforested Ecosystem* sections of this document.

Current habitat conditions in the planning area are moderately departed from the range of natural variation due to a century of fire suppression at low to moderate elevations and a recent large-scale spruce beetle outbreak in higher-elevation montane forest, which killed a large percentage of the mature and larger spruce trees on the Forest. In general, depending upon the ecosystem type, the Forest currently contains more sapling pole trees, more open stands, and larger areas of grass/shrub with forested potential than would be expected under the natural range of variation.

The recent spruce beetle outbreak has resulted in a significant decrease in closed canopy conditions and a rapid release of understory vegetation primarily associated with subalpine fir and aspen. The bark beetle outbreak has also resulted in a tremendous pulse of standing spruce snags, primarily in the larger size classes. Large log components are also being recruited as snags fall in certain areas. The longevity of spruce snags is expected to be variable depending upon factors such as location, site conditions, and susceptibility to windthrow; however, the majority of the spruce snags are expected to stand for at least 20–30 years with some standing for 50 to even 70 years (Mielke 1950).

The potential recruitment of new snags from green trees in the larger size classes may limit this ecosystem characteristic several decades in the future. In addition, a wide variety of human impacts (road building, timber harvesting, and stream alteration, among others) have resulted in negative influences that deviate from the natural range of variation. Over the longer term, current modeling indicates that the planning area will gradually revert back to conditions closer to the mean of the natural range of variation (Assessments 1 and 3), although the potential impact of climate change introduces uncertainty into this prediction. Some closed canopy conditions are projected to return to the spruce-fir ecosystem type within about five decades.

Sagebrush shrublands and greasewood flats dominate the lowlands on and just surrounding the Forest, with pinyon-juniper woodlands intergrading into them. Pinyon and juniper may be encroaching into what were recently grasslands or shrublands due to: past grazing, which potentially limits competition from herbaceous plants; fire exclusion, which allows more woody growth; and changing climate. Aside from pinyon and juniper, the foothill zone is a mixture of grassland, common mountain shrubs such as currants, rabbitbrush, chokecherry, skunk bush, limited areas of mountain big sagebrush, low sages, and mountain mahogany.

Above the foothill zone begins the lower-elevation portion of the montane zone, with mixed conifer forests interspersed with aspen and grasslands. Douglas-fir and ponderosa pine are the dominant trees in the montane zone. Ponderosa pine generally grows in scattered, park-like stands with abundant grass growth of Arizona fescue and mountain muhly in the understory. Douglas-fir intermingles with ponderosa pine on north-facing slopes and in ravines. With elevation gain, Douglas-fir eventually replaces the ponderosa pine. White fir commonly occurs in the upper elevations of the montane zone on the southern two-thirds of the Forest.

Moving up in elevation, subalpine stands are dominated by Engelmann spruce intermixed with subalpine fir, forming the most extensive forested cover type on the Forest. Arizona fescue and mountain muhly dominate areas that are too dry for tree growth. Rocky slopes and dry, gravelly areas will often support limber and bristlecone pine broken only by drainages, outcrops of rock, or fire disturbance. South-facing slopes have stands of Thurber fescue grassland. The spruce/fir forest receives the most precipitation of all the forest types. A great quantity of snow falls in this zone, which accumulates all winter and lasts into early summer; there are plants adapted to high amounts of moisture and a cold environment. Rocky Mountain whortleberry typically forms dense mats and is adapted to the cool, moist environment under Engelmann spruce.

At the highest elevations, forests give way to stunted trees with krummholz life forms and alpine vegetation communities. A willow/sedge community typically occurs at the transition into alpine zones. A tremendous variety of plants that are adapted to harsh conditions inhabit the high alpine regions. Low-growing sedge, kobresia, and forb communities dominate these alpine systems.

Riparian ecosystems border the streams that run through all these ecosystems, varying significantly depending on elevational gradient and geology. Overstory vegetation can be dominated by any of the conifer species discussed, or by blue spruce, willow, alder, aspen, or cottonwood, depending on elevation. The understory (plants growing underneath the taller plants) may be dominated by a variety of sedge, bluegrass, reedgrass, bentgrass, tufted hairgrass, rush, or many other water-adapted graminoid (grasses and grass-like plants) or forb species. Although riparian areas comprise generally only a very small percentage of the land area, they have high species diversity and density, and high productivity. Historically, water tables and stream flooding on the Forest were likely regulated by beaver dams, but with the reduction of beaver across the range, the abundance of beaver ponds and their associated communities have declined.

Some plant communities, such as the lower-elevation greasewood and wetlands, are dependent on snowmelt to produce spring flooding. Large disturbances in the higher elevations that influence canopy cover or changing climates can alter the timing of snowmelt. When snow melts quickly, rather than slowly, there are direct consequences for plant growth and for animals living in stream systems, and less directly, but consequentially, for other animals in, or dependent on, these communities. Also where there are explosive pulses in snowmelt combined with soil that is bare or disturbed from roads, timber harvest, livestock grazing or fire, soil erosion and sedimentation into streams has created problems for aquatic organisms throughout the stream systems. Additionally, the placement of roads in watersheds can alter water runoff patterns so that vegetation receives water differently than it would in the absence of the road because water can be cut off from places that used to be in its pathway.

Fire can be a large determinant of which vegetation community types are where, and in turn, the vegetation community types drive fire cycles. Frequently after fire in conifer stands, aspens establish and conifers will come up through their understories and gradually replace them. After a severe fire, mixed conifer stands may convert to montane shrublands.

The effects of fire management on the Forest are minor, with less than 0.2 percent of the landscape treated by thinning or prescribed fire per year, although the impacts of these activities vary in intensity and can have impacts ranging from years to decades. The area influenced by wildfire is roughly one-third of what would be within the natural range of variation if fire suppression did not occur. However, this amount is variable depending upon ecosystem type.

The potential influence of climate change on the ecosystems of the Forest is unknown, but some general trends are clear. Changes in temperature will change the growth of tree species (Rondeau et al. 2012, Vose et al. 2012), and this change may vary based on the particular species. Lower soil moisture will likely lead to higher levels of tree mortality and less regeneration. It is predicted that tree habitat will move upward in elevation and northward in latitude, and it is unclear whether tree species dispersal can keep up with this movement (Vose et al. 2012). Some ecosystems are particularly susceptible to climate change-related impacts. Plant and animal species in high-elevation alpine ecosystems, such as the Uncompahgre fritillary butterfly, may be pushed to extinction if warming temperatures reduce or significantly alter the function of their habitat (Alexander and Keck 2015).

Climate-driven extreme weather events may have rapid, dramatic effects on ecosystems. Multi-year droughts are linked to numerous other stressors and disturbances. Wildfires may increase, along with the possibility of increased insect outbreaks, invasive species introductions, flooding, erosion, and sedimentation (Vose et al. 2012).

Past livestock grazing practices affected not only shrublands but also influenced lower-elevation forests by removing fine, herbaceous fuels, which altered fire regimes (Romme et al. 2009). Livestock grazing continues to be a widespread activity on suitable rangelands, with influences on key ecosystem characteristics in various habitat types, primarily at mid- to lower elevations.

The spruce beetle outbreak affected up to 610,000 acres on the Forest from 2000 to 2016 (USDA Forest Service GSC 2016). Since that time, more forest has been impacted by spruce beetle, which makes it the most widespread forest pest as described by the State of Colorado for several years running (Colorado State Forest Service 2014). Many areas on the Forest affected by spruce beetle have 80 to 100 percent mortality in the overstory.

Threatened, Endangered, and Sensitive Species

Uncompahgre Fritillary Butterfly (Boloria acrocnema)

The Uncompahgre fritillary butterfly species is narrow endemic, restricted to isolated alpine habitats in the San Juan Mountains of southwestern Colorado (NatureServe Explorer 2017). The Uncompahgre fritillary butterfly is a little-known and poorly studied species; as such, past impacts to the species are hard to determine. The only known direct impact to the species was collection, both legal and illegal, by researchers and hobbyists. The extent to which collecting may have caused population declines is unknown. Collection of the species became regulated when the species was first listed under the Endangered Species Act.

The species was first petitioned for listing under the Endangered Species Act in 1979 (45 FR 8029), with a status review in 1984 determining that the species was warranted for listing but precluded (49 FR 2485 2488). Although the Uncompahgre fritillary butterfly was not listed at that time, the Forest Service and Bureau of Land Management signed an interagency agreement for the conservation of the butterfly. The species continued to be classified as "warranted but precluded" annually until 1990 when it was listed as endangered (50 FR 41721). The U.S. Fish and Wildlife Service neither designated nor proposed any critical habitat for this species; there are no defined primary constituent elements for the Uncompahgre fritillary butterfly's habitat.

The original 1990 Endangered Species Act designation for the species described five threats:

1. The present or threatened destruction, modification, or curtailment of its habitat or range,
2. Overutilization for commercial, recreational, scientific, or educational purposes,
3. Disease or predation,
4. The inadequacy of existing regulatory mechanisms, and
5. Other natural or manmade factors affecting its continued existence.

The recovery plan was approved in 1994 (U.S. Fish and Wildlife Service, 1994). At this point the Forest Service, Bureau of Land Management and U.S. Fish and Wildlife Service signed a new agreement to further conserve the species. This plan listed eight actions needed to achieve recovery of the Uncompahgre fritillary butterfly:

1. Enforce restrictions in collection of Uncompahgre fritillary butterflies,
2. Search for new colonies,
3. Monitor population status of existing and newly found colonies,
4. Obtain data on habitat requirement sand life history,
5. Monitor climatological trends at known colony sites,
6. Determine threats besides collecting,
7. Determine propagation techniques, and
8. Reintroduce and transplant butterflies.

Status reviews in 2007 (72 FR 19549) and 2016 (81 FR 33698) maintained the endangered status.

Existing Conditions and Trends

The range of the Uncompahgre fritillary butterfly is limited to the Rio Grande, Grand Mesa, Uncompahgre, and Gunnison National Forests, and the lands managed by the Gunnison Field Office of the Bureau of Land Management. Mt. Uncompahgre and Redcloud Peak were the only two colonies known at the time of listing and recovery planning. Shortly after completion of the recovery plan, an additional colony was discovered. Eight other colonies were discovered in subsequent years (U.S. Fish and Wildlife Service 2009).

Currently, 11 known colonies exist - three are quantitatively monitored with line transects, and the remaining 8 are monitored only for presence. Three of the colonies have been monitored for population status for more than 10 years, but the data are not currently sufficient for to determine that the population has been stable or increasing during this time. Much of the data collected before 2003 was unreliable due to changes in transect methodology and missing data (U.S. Fish and Wildlife Service 2009).

Five of the 11 known colonies occur within the planning area. Quantitative population data are not recorded for these sites; therefore, abundance and trend information for populations within the planning area have not been identified.

Based on the monitoring report for the 2014 field season (Alexander and Keck 2017), the ongoing qualitative monitoring of the 11 confirmed populations documented population persistence at only 9 of the 11 known colonies. Persistence has not been documented at Rio Grande Pyramid colony for 2 years and likewise for 7 years at the Machin Lake colony of the Canyon Diablo population. The lack of confirmation of Uncompahgre fritillary butterflies at the Machin Lake colony for 7 years and the Cinnamon Pass colony for more than a decade may indicate that some populations may be extirpated.

All known Uncompahgre fritillary butterfly populations are associated with large patches of snow willow (*Salix nivalis*) above 12,000 feet, which provides food and cover. Snow willow is found primarily on northeast-facing slopes, which are the coolest and wettest microhabitat available in the San Juan Mountains.

Females lay their eggs on snow willow, which is also the larval food plant, while adults take nectar from a wide range of flowering alpine plants (U.S. Fish and Wildlife Service 2015). Adults fly about late July into August. Flight is possible only in warm sunny weather. The species is biennial (requiring 2 years to complete its life cycle), but flies in both odd and even years (NatureServe Explorer 2017).

Recent studies involving the genetics of Uncompahgre fritillary butterfly investigated estimated levels of genetic variability and structure, and effective population size (Monroe et al. 2016). Despite low demographic numbers at these sites, the species has maintained relatively high heterozygosity at three sites. Genetic structure assessed indicated that despite separation on high mountain peaks, colonies were fairly well mixed, which is surprising for these weak fliers with very short growing and adult flight seasons. Estimates of effective population sizes were low, reflecting the life history and limited habitat range for the species. Comparisons at the site with historic and modern specimens revealed a consistent pattern in genetic indices. The data suggest that the three focal butterfly colonies exist as a metapopulation that persists due to low level migration between sites and ‘‘temporal leakage’’ via flexibility in development time in this biennial species.

The recent genetic work leads to three important implications for the management of Uncompahgre fritillary butterfly colonies and their habitat.

1. It appears to be imperative that all three colonies remain extant. The flow of individuals and genes among sites, even if at low levels, is critical to the persistence of this small metapopulation.

2. The Uncompahgre Peak colony may at times function as a population sink, while at other times, it may be self-sustaining for some period. The Uncompahgre site is the only one of the three that is impacted by an annual sheep drive in the area, which perhaps accounts for impacts to the population dynamics and genetics of this population.
3. Finally, the role of butterflies on intermittently occupied sites in terms of metapopulation dynamics is unknown.

It will be important to protect these sites from significant human impacts at least until the potential role of the individuals at the occasionally occupied sites is better understood. While direct anthropogenic threats to the species (e.g., collecting, trampling, and livestock grazing) have been mitigated to some extent, the potential effects of global climate change have not been directly addressed. Continuation of the current monitoring program and additional population genetics surveys are recommended for this species.

Changes in temperature and precipitation may be an issue for this species, as is commonly thought for Alpine-obligate species (National Wildlife Federation 2005). The species cannot ascend to higher elevations to escape the impacts of a warmer temperatures, and lacks the ability to travel the distances needed to disperse to cooler areas farther north. There are no reasonably foreseeable future programmatic actions that would have direct or indirect effects on the Uncompahgre fritillary butterfly.

Direct and Indirect Effects

All action alternatives include revised management direction for Uncompahgre fritillary butterfly habitat in alpine areas with snow willow. Generally, there will be very little, if any, adverse impact to the Uncompahgre fritillary butterfly from alternative B. Increased visitor use and dispersed recreational pursuits likely are the primary concern. However, all but perhaps one of the Uncompahgre fritillary butterfly populations on the Forest occur in remote areas that are not known to attract considerable human foot traffic at this time; therefore, visitor use and dispersed recreational pursuits should have minimal influences on Uncompahgre fritillary butterfly populations or habitat. Protective measures prescribed in revised management direction would help manage potential negative impacts.

Overall, the species will likely benefit from these protective measures. However, continued monitoring such as that associated with the Uncompahgre Fritillary Butterfly Recovery Team Partnership is essential to documenting habitat trends and potential conservation concerns associated with the needs and success of the protective measures associated with the plan components.

The largest difference between the effects that the alternatives would have to the Uncompahgre fritillary butterfly is that the some of the known population sites on the Forest would overlap Management Area 1.1a with Colorado roadless areas in alternative D but would remain only Colorado roadless in alternatives A, B, and C. However, this would likely have no impact to the Uncompahgre fritillary butterfly, as the protective measures incorporated into both management areas and across all alternatives would be likely to be strongly protective of the species and its habitat.

Effects on Uncompahgre Fritillary Butterfly from Vegetation Management

Uncompahgre fritillary butterfly habitat (snow willow) has no overlap with suitable timber harvesting areas; therefore, impacts to the Uncompahgre fritillary butterfly from the timber program would be negligible to nonexistent, with no adverse effect.

Timber harvesting levels vary among alternatives, but it is likely that the impacts to the Uncompahgre fritillary butterfly from this program would not vary, due to the lack of spatial overlap between harvest-sized timber and Uncompahgre fritillary butterfly habitat.

Effects on Uncompahgre Fritillary Butterfly from Fire Management

There would be no measurable influence on the Uncompahgre fritillary butterfly due to fuels reduction associated with prescribed and use fires and fuels management. Fuels reduction activities are unlikely in the high subalpine spruce-fir forests that border the alpine tundra ecosystem. While wildland fire use may be an activity in the subalpine forests, the chances that such fires can extend into the more fire-resistant alpine areas that make up Uncompahgre fritillary butterfly habitat is highly unlikely. Fire control or suppression activities would be highly unlikely to occur in the alpine tundra ecosystem, let alone the north to northeast glacial cirque basins that support known populations of Uncompahgre fritillary butterfly and receive afternoon thunderstorm showers nearly every day during the summer season, particularly after monsoon season begins in early July.

The unlikelihood of fire in Uncompahgre fritillary butterfly habitat reduces the probability that such control efforts could cause unintentional harm to the species or its habitat. Fire and fuels management will have no adverse effect on the Uncompahgre fritillary butterfly or its habitat.

It is very unlikely that even the most intense wildfires could burn into the Uncompahgre fritillary butterfly habitat regardless of Forest Service management actions. As such, impact to the Uncompahgre fritillary butterfly from fire and fuels management would not vary from one alternative to the next.

Effects on Uncompahgre Fritillary Butterfly from Livestock Grazing

All action alternatives include revised plan direction for Uncompahgre fritillary butterfly habitat, specific to snow willow in alpine areas. The Forest also already prohibits sheep grazing and trailing in occupied Uncompahgre fritillary butterfly habitat and there is no scheduled cattle grazing on Uncompahgre fritillary butterfly habitat within the plan area. However, an active cattle allotment boundary overlaps one known colony area. Cattle grazing within and around this colony area was documented during one field season but has not been noted again since that time (Alexander 2009). As grazing leases cycle through permit renewal, revised management direction in all action alternatives would be taken into consideration, ensuring that any negative impacts associated with grazing are prevented or mitigated.

However, wandering bands of domestic sheep have still been observed grazing on some colony areas, including permitted sheep from the Rio Grande National Forest onto the San Juan National Forest and Grand Mesa, Uncompahgre, and Gunnison National Forests (USDA Forest Service files, Snow Mesa Allotment, 2016).

Minimal impacts from the livestock grazing program to the Uncompahgre fritillary butterfly may, however, occur. This would not vary among alternatives because grazing has already been prohibited in known Uncompahgre fritillary butterfly habitat on the planning unit, and because revised plan direction can provide a second level of protection from grazing, or to protect any new patches of habitat that may be discovered.

This would not vary among alternatives.

Effects on Uncompahgre Fritillary Butterfly from Road Construction, Reconstruction, and Management, and Motorized Off-Highway Travel

There are no roads or motorized routes within or near Uncompahgre fritillary butterfly habitat. All known Uncompahgre fritillary butterfly populations are either in wilderness or Colorado roadless areas in all alternatives. Road construction, reconstruction, and management and motorized off-highway management will have no impact on the Uncompahgre fritillary butterfly or its habitat and no adverse effect. This would not vary from alternative to alternative.

Effects on Uncompahgre Fritillary Butterfly from Trail Management, and Developed and Dispersed Recreation

Although there are no trails or developed recreation sites in or near any known Uncompahgre fritillary butterfly habitats or populations, increasing recreational traffic, including off-trail use, is consistently noted as a potential threat to known Uncompahgre fritillary butterfly colonies, particularly colonies on an adjacent Forest (Alexander and Keck 2016). There is some potential for dispersed recreation to have adverse impacts to the Uncompahgre fritillary butterfly and its habitat. All action alternatives include revised plan direction to help manage these potential impacts. This does not completely eliminate the potential for damage to the Uncompahgre fritillary butterfly or its habitat, however, as revised plan direction is still contingent on monitoring to trigger implementation. The revised management direction will still likely be enough to prevent any major or moderate adverse impacts to the species and habitat from dispersed recreation. Short-term impacts to habitat and individuals are possible from dispersed recreation foot traffic, as is no impact, depending upon accessibility to the colony area. Depending upon the colony area, the probability of impacts from recreational activities may occur on an annual or periodic basis, or not at all. Trampling by recreational foot traffic has been noted as a management issue in some colony areas; however, the overall effect of this activity is not known.

In all plan alternatives, known Uncompahgre fritillary butterfly populations continue to be in roadless, or upper tier roadless, or wilderness areas. None of the known populations occur in any of the management areas focused on recreation. As a result, management impacts from recreation to Uncompahgre fritillary butterfly will not vary among alternatives.

Effects on Uncompahgre Fritillary Butterfly from Designation of Wilderness, Wild, Scenic, and Recreational Rivers, Research Natural Areas, and Special Interest Areas

Wilderness designation is generally protective of the Uncompahgre fritillary butterfly except perhaps for recreational activities, which might increase along with an increase in designated wilderness because of the increased number of visitors. Protection and management of the habitat for this species does not require any equipment or methods that are incompatible with wilderness designation. Wilderness designation does prevent many incompatible actions from occurring on Uncompahgre fritillary butterfly habitat. Of the five colonies known in the planning area, two occur in designated wilderness, the other three are in Colorado roadless rule upper tier areas. The intensity of the impact to the species may be difficult to qualify, but will be generally positive and long term, with no adverse effect.

Alternatives A, B, and C would not change the wilderness designation at the location of any of the known Uncompahgre fritillary butterfly colonies. Alternative D would overlay the Management Area 1.1a – Recommended Wilderness designation over the three populations that occur in roadless areas. This would likely have no impact to the management of the Uncompahgre fritillary butterfly in those areas, as both designations (wilderness or roadless) are generally protective of the species and would not change the suite of plan components that are also protective of the species.

The alpine saddles and meadows that make up the habitat for the Uncompahgre fritillary butterfly are not in or near any of the wild, scenic, and recreational river corridors nor in research natural areas in any of the alternatives. In alternative D, the Congressionally Designated Trail Management Area tied to the Continental Divide National Scenic Trail may overlap habitat, but Forestwide plan direction focused on the species and related key ecosystem characteristics would still require mitigation of any impacts from uses related to the trail.

Effects on Uncompahgre Fritillary Butterfly from Mineral Resource Activities

There are no active minerals extraction sites near any of the Uncompahgre fritillary butterfly populations or habitat on the Forest. Populations that are in wilderness are protected from any new mineral claims entry, remaining populations are within Colorado roadless rule upper tier areas, and this plan revision has no impact and no change to minerals management in Colorado roadless rule areas (which includes, among other things, no new surface occupancy for new oil and gas leases). As a result, within the context of this plan revision, minerals extraction will have no impact to this species beyond those already analyzed by the environmental analysis that was done for the Colorado Roadless Rule. This would be consistent throughout the alternatives.

Cumulative Effects

The Uncompahgre fritillary butterfly was originally considered a little-known and poorly studied species. In the past several years, however, on-going research has advanced knowledge of the species, involving quantitative abundance estimates, phylogenetic relationships within the same and associated genera, and genetic relationships among populations, colonies, and sub-colonies. This information, along with qualitative presence/absence sampling at all sites on the Forest, helps inform current baseline conditions for assessing potential impacts to the species over time. Initially when first named as a new species, the only known direct impact involved collection, both legal and illegal, by researchers and hobbyists. The extent to which that collecting may have caused population declines is unknown. Collection of the species became regulated when the species was first listed under the Endangered Species Act.

Current trends in reduced population persistence at sites qualitatively sampled, and recent general trends in abundance estimates at sites quantitatively sampled, suggest concerns for the continued persistence of this species (Alexander 2009).

Until more information can be developed it is difficult to state the cumulative effects outside of current trends. Considerations and protection measures required by the Endangered Species Act are expected to continue to minimize potential known adverse effects, including cumulatively.

Based on the analysis for the Uncompahgre fritillary butterfly, neither the proposed action, nor any of the action alternatives, would result in measurable cumulative effects.

Black-Footed Ferret (Mustela nigripes)

Existing Conditions and Trends

This species was once present within the planning unit but has not been documented here since 1930. The black-footed ferret was first listed as endangered under the Endangered Species Act in 1967 (32 FR 4001) and was declared extinct in 1979, only to have a remnant population discovered 2 years later in Wyoming. Subsequent captive breeding efforts have resulted in reintroduction efforts. Should black-footed ferrets be reestablished on the Forest, whether through reintroduction or naturally, the Endangered Species Act would require specific protection and conservation measures. Additional information on black-footed ferrets is contained in the wildlife report in the project record.

Canada Lynx (Lynx Canadensis)

Existing Conditions and Trends

Canada lynx were first considered for listing in 1980 (47 FR 58454). The U.S. Fish and Wildlife Service found that although it might have been appropriate to list the species, information needed to support that decision was lacking at the time. After multiple reviews, petitions, and at least one environmental impact statement, the species was finally listed as threatened in the 48 contiguous states in 2000 (65 FR 16053). Critical habitat for the contiguous United States distinct population segment) was first designated in 2006 (71 FR 53355), revised in 2009 (74 FR< No. 36), and revised again in 2014 (79 FR No. 177) – none of which occurs in the Southern Rockies or the planning area. The 2014 rule found that the primary constituent elements lynx need for reproduction and survival do not occur in the quantity and spatial arrangement necessary to provide for conservation of the species. There is currently no proposed or designated critical habitat in the Southern Rockies, including the Forest. In September of 2016, however, the 2014 rule was remanded and the U.S. Fish and Wildlife Service was directed by the U.S. District Court of Montana to develop a new proposed critical habitat rule that includes the Southern Rockies and the Forest (9th Circuit, U.S. District Court of Montana, Case 9:14-cv-00270-DLC, Document 62, 09/07/2016).

In 1999, Colorado Parks and Wildlife initiated a lynx recovery program intended to augment any existing populations in the Southern Rockies with transplants from Canada and Alaska to re-establish a self-sustaining breeding population. The augmentation program resulted in a total of 218 lynx being transplanted into the San Juan Mountains during 1999–2006.

The Forest represents a large portion of the core area for lynx reintroduced to Colorado, with about 85 percent of the 218 lynx reintroduced to Colorado during 1999–2006 being released within the planning area. The vast majority of lynx within Colorado remains and reproduces in the high-elevation spruce-fir zone in the southwestern portion of the state, including the Forest. Currently, lynx continue to utilize and reproduce on the Forest, and local spruce-fir habitats remain essential to their eventual recovery and delisting (USDA Forest Service 2014).

A total of four linkage areas have also been delineated on the Forest. Two of the primary linkage areas, Wolf Creek Pass and North Pass, have been documented as having considerable use by lynx as they cross Highway 160 and 114, respectively (Shenk 2005). Lynx habitat extends across administrative boundaries within the greater San Juan Mountains area and includes the Grand Mesa, Uncompahgre, and Gunnison National Forests. Connective habitat between administrative units in the San Juan Mountains and beyond is essential for facilitating movement of Canada lynx across the landscape.

Currently, the 2011 habitat map remains the primary descriptor of baseline conditions for lynx habitat on the Forest. However, extensive habitat changes have occurred since that time due to a spruce beetle outbreak focused primarily in the spruce-fir ecosystem. Aerial surveys (USDA Forest Service 2017c) to detect insect and disease influences indicate widespread mortality in the mature spruce component of the spruce-fir ecosystem type, and to a lesser extent other forest types within the planning area. Data from flights conducted from 2010 to 2014 show that approximately 782,137 acres of suitable lynx habitat were affected by spruce beetle mortality, while about 221 acres were affected by mountain pine beetle mortality. Severity of mortality varies across the landscape, ranging from less than one tree per acre to more than 100 trees per acre in some areas. As of 2017, overstory mortality had increased to 100 percent of the spruce-fir forested ecosystem (USDA Forest Service 2017c). This change in habitat conditions directly overlaps with the core habitat for lynx on the Forest and has resulted in a significant change to the key ecosystem characteristics known to provide high-quality habitat conditions for the species. A recent update in habitat baseline conditions identify 96,226 (9.2 percent) of the habitat as currently unsuitable (USDA Forest Service 2017d). As of spring 2017, the percentage of overstory mortality remains higher in the north and mid portions of the Forest and more variable in the south where mature green tree components remain but are also undergoing change due to spruce beetle mortality.

In 2013, a collaborative study between the U.S. Forest Service Rocky Mountain Research Station, Colorado Parks and Wildlife, the Rio Grande National Forest, and other partners was initiated to investigate how lynx respond to forests heavily influenced by spruce bark beetles in the San Juan Mountains of southern Colorado. The primary study area overlaps core lynx habitat on the Forest. The purpose of the study is to address the key management questions associated with the identification and maintenance of suitable habitat for lynx and primary prey species in relationship to natural disturbance processes such as bark beetles and wildfire, and an expected increase in post-beetle forest management activities, such as timber salvage (USDA Forest Service 2014).

The preliminary results from the lynx study appear to be closely associated with the expected response of key ecosystem characteristics in relation to the disturbance ecology of spruce-fir forests. In Colorado, the primary vegetative response from spruce beetle outbreaks is the release and accelerated growth of understory fir and spruce rather than new seedling establishment. With the death of canopy trees, previously suppressed understory trees sustain high growth rates for 40 to 100 years or more (Veblen et al. 1991a, 1991b). Based on the preliminary study results, both lynx and snowshoe hare appear to responding to the understory release associated with the spruce beetle outbreak, with mean snowshoe hare densities exceeding any other know location in Colorado (Ivan 2017). Other key prey species such as red squirrel, however, are responding negatively to the loss of green canopy conditions that provide food and cover resources.

Natural History and Key Ecological Functions

Canada lynx habitat in Colorado primarily occurs in the subalpine and upper montane forest zones. Recent analysis of radio-collared reintroduced lynx in Colorado indicates that the majority of the habitat used occurs from 9,900 to 11,620 feet in elevation (Theobald and Shenk 2011). Forests in these zones typically contain deep winter snows and are dominated by subalpine fir, Engelmann spruce, aspen, and lodgepole pine. A preference for these forest types, particularly spruce-fir associations, has been documented by radio-telemetry and tracking techniques associated with lynx reintroduced to Colorado (Theobald and Shenk 2011). Other habitats used by reintroduced lynx include spruce-fir/aspen associations and various riparian and riparian-associated areas dominated by dense willow (Shenk 2009).

In Colorado, both small-diameter lodgepole stands and mature spruce-fir stands support the highest density of snowshoe hares, although the latter may be of more importance on a year-round basis due to the long-term persistence and distribution of mature spruce-fir stands (Ivan 2011). Reintroduced lynx in Colorado are also preying on red squirrels, cottontails, and other alternate prey items. Red squirrels are closely associated with mature forest conditions, and would occur sympatrically with snowshoe hare as an important alternate prey species (Buskirk et al. 2000). The increased use of riparian-willow systems by reintroduced lynx during late summer and fall is also considered to be associated with alternate prey sources (Shenk 2009).

Births by reintroduced lynx in Colorado occurred in late May to mid-June (Shenk 2006). All den sites found in Colorado have occurred within the spruce-fir zone on steep, north-facing slopes and are most often associated with substantial amount of large-diameter woody debris (Merrill 2005, Shenk 2009). The average elevation at Colorado den sites is 11,004 feet (Shenk 2009).

Lynx are known to move long distances, but open areas, whether man-made or natural, may not be used as extensively (Mowat et al. 2000). However, the Southern Rockies consist of more heterogeneous forest types and their response to natural or created openings may differ (Ruggiero et al. 2000). The habitat use information for lynx in Colorado indicates that canopy closures of at least 40 percent are important at the site-scale, regardless of the type of cover involved (Shenk 2006). Additional analysis of radio-collared data for reintroduced lynx in Colorado indicates that the average proportion of forest (upper montane) in lynx habitat was 0.65, with the majority occurring in areas with at least 20 percent forested (upper montane) cover. Habitat use was also associated with distance from large patches (more than 50 hectares, or 124 acres) of forest (upper montane) cover, with the majority of habitat within 3.35 km (2.1 miles), and the average at 0.36 km (0.2 mile). These data indicate that most lynx use in Colorado is associated with larger contiguous blocks of forest that is primarily dominated by spruce-fir forest cover types.

Lynx reproductive rates in Colorado have varied greatly since kittens were first documented in 2003. After den visits identified 16 kittens in 2003, researchers found 39 kittens in 2004, 50 kittens in 2005, 11 kittens in 2006, 11 kittens in 2009, and 14 kittens in 2010. During the 2006, 2009, and 2010 seasons, Colorado Parks and Wildlife field crews documented that Colorado-born lynx had successfully produced third-generation Colorado kittens. In 2010, researchers estimated that 30 to 40 percent of female lynx bore litters of kittens (Colorado Parks and Wildlife 2017a).

Ecological Conditions for Recovery, Conservation, and Viability

Specific ecological conditions for recovery, conservation, and viability of Canada lynx on the Forest are best described in the Southern Rockies Lynx Amendment (USDA Forest Service 2008). All key criteria in the Southern Rockies Lynx Amendment management direction (objectives, standards, and guidelines) are included in all alternatives. Some key ecological conditions considered important on the Forest include:

- Recognition that lynx conservation and recovery is a multi-unit, landscape-scale issue that involves cross-boundary coordination and consistency.
- A conservation focus on late-successional spruce-fir cover types in combination with aspen and cool-moist mixed-conifer stand components represents the majority of the high-quality lynx habitat locally. High-elevation willow-riparian systems also represent high value for summer foraging use. In the post-spruce beetle environment, a focus on stands that previously were mapped as 4c structural class still contain the structural legacies, green cohorts, and understory components that most likely provide for the key life history requirements of lynx and key prey species.
- High-quality lynx analysis units that are well-connected within and among lynx analysis units.

Connectivity attributes that facilitate movement should be further defined and mapped across the unit and adjoining unit landscapes.

- Recognition of high-value movement and dispersal areas that may require a management focus even when outside of existing lynx analysis units or known occupied reproductive habitat. A local example is the North Pass area on the Saguache Ranger District that may provide for dispersal and ingress of lynx in and out of the local core area.
- Protection, maintenance, and restoration of dense understory conditions that support primary prey species (snowshoe hare), particularly when associated with late-successional spruce-fir cover types or post-bark beetle conditions in former late-successional green forests.
- In the post spruce-beetle outbreak condition, a refocus on what constitutes high-quality habitat for key prey species, lynx, and reproduction.
- Uncompacted snow conditions and management of over-snow vehicle route densities.

Threats and Risk Factors

The 2000 Lynx Conservation Assessment and Strategy (Ruediger et al. 2000) identified several specific management activities and practices termed *risk factors* for the Southern Rockies geographic area. Risk factors affecting lynx productivity included fire exclusion, grazing, and winter recreational uses that create compacted snow conditions. The Southern Rockies Lynx Amendment (USDA Forest Service 2008) incorporated and addressed the following risk factors for lynx:

- Fire exclusion is not considered a factor locally on the Forest.
- Grazing influences on riparian willow are not considered a broadscale factor influencing high-elevation riparian willow habitat on the Forest; however, it can be a localized issue in certain areas, particularly those with a meadow or grassland park interface.
- Road, trail, and recreational activities that result in snow compaction may facilitate increased access into lynx habitat and competition for food resources by competitors (primarily coyotes). Over-snow vehicle use is noted as a local concern on the Forest, with use demand on the increase.
- Risk factors affecting lynx mortality include trapping, predator control activities, predation by mountain lions, and collision with vehicles on major highways and many of the major mountain passes in the Southern Rockies Management Geographic Area.
- Risk factors affecting lynx movement include barriers to movements such as major highways and associated development within rights-of-way. Private land development, especially along road corridors in mountain valleys, also may fragment habitat and impede movement of lynx. Urban expansion and development on private land has further fragmented an already patchy distribution of lynx habitat, many times in response to development or expansion of a developed recreational facility on National Forest System lands within lynx habitats. Currently, the Rio Grande National Forest supports four key linkage areas that highlight highway crossing and/or movement concerns.

The threats and risk factors identified in the Southern Rockies Lynx Amendment and the management direction to address them remain valid on the Forest. Specific threats and risk factors in the post spruce beetle environment include:

- Inability to map suitable habitat across lynx analysis units and adjacent national forest units due to rapid changes from spruce beetle outbreak.
- Uncertainties associated with baseline habitat condition changes due to significant natural events such as spruce beetle outbreaks, and the relationship of these changes to ongoing management activities that further influence baseline conditions. Uncertainty in management activity thresholds.
- Uncertainty in what constitutes high-quality habitat in the post spruce beetle landscape, and revised management direction to address these conditions in association with vegetation management.
- A significant increase in over-snow vehicles, potential snow compaction, and disturbance.

Since listing, most Federal land managers throughout the range of the Canada lynx, including national forests in the Forest Service Rocky Mountain Region, have formally amended management plans to conserve lynx and hare habitats (U.S. Fish and Wildlife Service 2013a, USDA Forest Service 2008).

Recent modeling suggests that changes in temperature and precipitation are likely to impact lynx in the contiguous North American distinct population segment. Although the timing, magnitude, and consequences of these impacts are difficult to predict, lynx habitats and populations in the contiguous United States are likely to be smaller and more isolated in the future and, therefore, more vulnerable to other threats (U.S. Fish and Wildlife Service 2013a).

Direct and Indirect Effects

The Southern Rockies Lynx Amendment provides an overview of all activities that might influence Canada lynx and the key ecosystem characteristics that define their primary habitat and that of their important prey species. The management direction that addresses these activities is incorporated into the action alternatives for the plan revision. Of these, forest vegetation management is considered the most influential, primarily because of the potential effects of vegetative structure that supports snowshoe hare and, to a lesser degree, other important prey species. Therefore, the forest vegetation management (timber) program has the greatest potential to influence Canada lynx depending primarily upon where these activities are located. Conversely, forest vegetation management can also be an important tool for improving lynx habitat both spatially and temporally over time and thus have beneficial influences to lynx habitat.

Wildland fire can have extensive negative influences on lynx habitat locally because of the fire regime associated with local subalpine forests. In the short to mid-term (several decades), these fires can have detrimental effects on lynx habitat quality depending upon factors such as location, scale, and intensity. Conversely, wildland fire can be a beneficial influence on lynx habitat over the long term if burn intensities and spatial aspects of burn and unburned areas are in close proximity to each other.

Recreational programs may have negative influences on lynx habitat, primarily as associated with winter recreational use of motorized over-snow machines, or snowmobiles. Effects can include disturbance and displacement, and facilitation of competition by other carnivores, such as coyotes, for food resources. Livestock grazing can and has been documented as 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. Most grazing issues involving lynx habitat have occurred at mid-elevations where drier riparian habitat vegetation can be more readily influenced by livestock. However, upper elevation willow carrs can also be influenced.

Other human uses and key habitats involving road management, summer recreation, linkage areas, and habitat connectivity can also be influential depending on location, scale, and intensity.

Programs that have the greatest potential to impact lynx are those that have the potential to affect the vegetative cover needed by lynx or their prey base. Timber harvest, fire, fuels management, and, to a lesser degree cattle grazing, all have the greatest potential to impact the required vegetative cover for lynx. Over-snow recreation has the potential to disturb and displace lynx and increase snow compaction levels. Dredging activities have potential to interfere with lynx movements. Vegetation management activities that occur during the reproductive season are the likely the only disturbances that have much potential to cause direct mortality to lynx. This effect can be mitigated by timing restrictions in key reproductive habitat until such time as the kittens can likely move between maternal dens (after at least July 15).

Effects on Canada Lynx from Vegetation Management

Since amending the existing plan, or alternative A, in 2008, the Southern Rockies Lynx Amendment has mitigated most impacts to lynx through vegetation management activities. The Southern Rockies Lynx Amendment has since been integrated into all alternatives, with revised direction in alternatives B, C, and D, to address the changed condition in spruce-fir. Since the revised plan will include all plan components of the Southern Rockies Lynx Amendment, any effects from vegetation management will continue to be mitigated. There is no expected increase in effects to lynx or lynx habitat.

More detailed consideration of the effects of vegetation management on lynx habitat can be found in the wildlife report in the project record.

Effects on Canada Lynx from Fire Management

As noted above, the 2000 Lynx Conservation Assessment and Strategy noted that fire exclusion is not considered a factor on the Forest. Revised plan direction for fire management in all action alternatives focuses on the natural role that fire plays in the ecosystem and addresses natural ignition wildfires where they would only be extinguished when they are a threat to human life or property, or if they risk the ability of the site to sustain ecosystems. All action alternatives also include plan direction for fire management zones that create a prioritization framework for fire management tied to resource protection or risks to human life and property.

More detailed consideration of the effects of fire management on lynx habitat can be found in the wildlife report in the project record.

Effects on Canada Lynx from Fuels Management

Fuels management activities in lynx habitat across all alternatives are not expected to be applied frequently on a landscape scale because of the associated fire regime. However, pile burning and other slash clean-up activities associated with activity fuels from timber harvest may be used frequently. Fuels management activities have the potential to be have negative effects on lynx habitat. These effects are addressed in plan direction in alternatives B, C, and D, however, to avoid negative impacts to lynx habitat, maintaining the vegetative structure and connectivity required by the species.

Effects on Canada Lynx from Livestock Management

Cattle grazing can reduce shrub size and vigor, generally leading to more open conditions in contrast to the lynx's preference for dense undergrowth (Aubry et al. 2000). Cattle grazing can reduce winter forage and cover for snowshoe hares and is correlated with decreases in snowshoe hare abundance. The primary concern from livestock grazing on lynx habitat involves browsing and trampling impacts on understory or riparian-associated species such as aspen and willow, which function as important cover and forage habitat for prey species such as snowshoe hare. High-elevation riparian willow typically functions as a key habitat for a variety of prey species during the summer period. Grazing in these areas can reduce the cover and forage value of these areas. The current management direction from the Southern Rockies Lynx Amendment regarding livestock grazing has been incorporated into the plan revision. In most cases, cattle grazing tends to be a minor influence on these habitat types due to their elevation and inaccessibility to livestock. Therefore, no updates to the management direction regarding livestock grazing have occurred.

The existing management direction regarding livestock grazing, in addition to the new plan components, is expected to maintain the vegetative conditions associated with lynx and their important prey species.

Effects on Canada Lynx from Road Construction and Reconstruction, Road Management, and Motorized Off-Highway Travel

High-volume roads and highways are known to have an impact on lynx movement and habitat connectivity, but the impact of lesser-used roads and native-surface roads is less well understood. Road-related mortality of lynx occurs most often when highway traffic volume approaches or exceeds 4,000 vehicles per day. Given the slower speeds and reduction in use associated with native-surface National Forest System roads, direct and indirect impacts are less likely to occur. In some cases, however, they may affect lynx behavior by deferring intended crossings and movements. However, such impacts are expected to be minimal depending on road density values in particular areas, especially when in association with other high-use recreation areas such as developed campgrounds.

Plan direction in all action alternatives could be used to defer road construction and maintenance projects in lynx denning habitat to avoid take when the dens are in use. Revised plan direction also allows for the use of seasonal closures to protect wildlife and fisheries habitat. If used properly, this plan direction could ensure that the road network has no more than a negligible impact to the lynx population, commensurate to a minor adverse effect in the form of unintentional harassment.

Snowmobile use by recreationists often directly overlaps mapped lynx habitat because of human preferences for high-elevation, deep snow areas. Lynx can be negatively affected by use of over-snow vehicles due to noise and displacement. Winter periods can also be particularly stressful for lynx as they establish and reoccupy winter home ranges that will supply the food resources to feed themselves and often the kittens from the previous year, and provide them with enough resources to prepare for the coming breeding season. The probability of negative impacts occurring likely increases with increasing snowmobile use and the amount of accessible terrain. The current increasing trend in snowmobile use in Colorado and on the Forest and the increased ability of the machines to pioneer into previously secluded habitat areas has the potential to increase potential displacement and/or disturbance of lynx in some areas. For example, requests for guide permits to lead snowmobile groups in spruce-fir ecosystems that also support lynx are a recent activity on the Forest.

Road and trail grooming for snowmobile access also results in snow compaction. In some cases, extensive play areas used repeated by snowmobiles also results in snow compaction. Baseline conditions regarding snow compaction are associated with the Southern Rockies Lynx Amendment and have been incorporated into all action alternatives. Existing baseline conditions (miles of groomed over-snow routes, i.e., compacted snow) for the Forest for alternative A are listed in Table 53.

Table 53. Miles of estimated designated and groomed winter routes on the Forest

[LAU, lynx analysis unit. Information is from Table 3-24 in the final environmental impact statement for the Southern Rockies Lynx Amendment (USDA Forest Service 2007). This table represents alternative A, or the Forest baseline in relationship to Section 7 responsibilities and Southern Rockies Lynx Amendment management direction.]

Rio Grande National Forest	Total Miles of Designated Routes	Total Miles Groomed Routes	Total Miles of Groomed or Designated Recreation Winter Trails and Routes in Lynx Habitat within LAUs	Total Miles of Groomed or Designated Recreation Winter Trails and Routes within LAUs
Total	613	613	196	319

Groomed routes are managed under special use permit on the Forest, while winter trails and routes may or may not be.

Under all alternatives, the snow compaction baseline is not to be exceeded without following the objectives and guidelines in the *Human Uses* section of the Southern Rockies Lynx Amendment, and documenting the rationale for this deviation. Additional GIS work completed in 2016 resulted in a new map of snow routes and suspected compacted routes for the Forest. On the basis of this mapping effort, the compacted routes are believed to be similar to the 2008 Southern Rockies Lynx Amendment baseline, but total routes used by snowmobiles had nearly doubled.

For more information on over-snow activities, see the *Sustainable Recreation* section.

Snow compaction is considered to be a potential issue for lynx because other predators such as coyotes may take advantage of hard-packed over-snow routes created by snowmobiles to access areas of deep snow habitat that were formerly inaccessible to them. This may result in competition for resources such as snowshoe hare that lynx depend upon. While use of snow-compacted routes by coyotes is a commonly observed occurrence locally, the effects of this increased access on lynx are uncertain. If further research indicates that it is a problem locally, then seasonal or local closures could mitigate the problem.

The forest plan revision decision will determine the suitability of over-snow areas, but delineated routes will not be determined until the travel management planning process has been completed.

Effects on Canada Lynx from Trail Management, Developed Recreation, and Dispersed Recreation

The impact that outdoor recreation may have to lynx is not clear, although a number of studies are underway (Maze 2013). Nonmotorized over-snow travel may have a similar effect, although at a lesser scale and intensity. This may not directly impact lynx as the species spends the great majority of its time in thick brush and timber that is not generally suitable for over-snow travel, mechanized or not.

There is no indication that other types of recreation have much impact on lynx in their preferred habitat, as hikers and other recreationists generally stay out of the thickest brush that makes up the preferred lynx habitat.

In alternative A, management direction for trails, and developed and dispersed recreation reflects the 1996 travel management plan and the Southern Rockies Lynx Amendment. All action alternatives include the existing Southern Rockies Lynx Amendment direction as well as additional direction tied to the changed condition in the spruce-fir forest. Alternative B proposes a slight increase in acreage of wilderness and wild, scenic, and recreational rivers, which would slightly limit trails, and developed and dispersed recreation, while alternative C would provide the greatest opportunities for motorized dispersed recreation. Alternative D would limit the locations of developed recreational opportunities and motorized dispersed recreation in proposed special interest areas, and recommended wilderness acreage. Overall, alternative C would have the most negative effects on lynx while alternative D would have the most beneficial effects.

Effects on Canada Lynx from Designation of Wilderness, Wild, Scenic, and Recreational Rivers, Research Natural Areas, and Special Interest Areas

Activities prohibited by wilderness designation include the use of mechanical transportation, motorized equipment, and permanent structures, which can have negative impacts on lynx and their habitat, depending upon location, scale and intensity.

Overall, wilderness designation would be beneficial to lynx. Alternatives vary in the way they address wilderness, but that would have little or no impact on how wilderness impacts Canada lynx. The designation of Management Area 1.1a in alternative D might have some impact on lynx over the very long term, but that is uncertain. Alternative B includes an additional 59,000 acres and alternative D includes an additional 285,000 acres of wilderness, which suggests that alternative D would be the most beneficial to lynx.

Wild, scenic, and recreational river designations would also have a positive impact on lynx. Lynx use riparian areas as part of their primary movement zones. The increased scrutiny of actions proposed within the eligible designated wild, scenic, and recreational river areas, and the emphasis on the maintenance of natural conditions in those areas, would ensure that measures protective of lynx would be considered.

Alternatives B, C, and D all contain the same proposed areas to be included in the wild, scenic, and recreational eligible river designation and therefore the same effect from this designation to Canada lynx. This impact is expected to be very minor, if measurable at all, as the proposed designations do not overlap important habitat areas for Canada lynx.

Existing special areas in alternative A have no specific benefit for lynx. Alternative D, however, includes a significant increase in acreage tied to special interest areas and recommended wilderness areas that include suitable habitat for lynx, including the Spruce Hole/Osier/Toltec and Deep Creek Special Interest Areas. All action alternatives include plan direction from the Southern Rockies Lynx Amendment, however, with revised plan direction specific to Canada lynx in late-successional spruce-fir forests to provide for suitable habitat. Additional special designations would not elevate management direction already required because of the threatened status of the species.

Effects on Canada Lynx from Mineral Resource Activities

Mineral resource extraction activities that might impact lynx include hard rock, or locatable mining, recreational dredging, and utility corridors to support those activities. Recreational dredging occurs in riparian areas that often function as travel routes for Canada lynx among other species. Plan direction in alternatives B, C, and D encourages the retention of instream and riparian vegetation, which is a key component of lynx movements. Use of equipment in these areas could have some adverse impact to lynx in the form of unintentional harassment. The impact of minerals resources is expected to be minor.

Cumulative Effects

There are no previous actions that result in, or add, any adverse direct or indirect effects to lynx and lynx habitat. Any effects from previous actions have been accounted for in the existing conditions and trends.

As noted in the listing decision, current forest management practices are considered one of the primary effects. Due to the Southern Rockies Lynx Amendment and Endangered Species Act protections, there are few if any direct and indirect effects at the programmatic scale. Vegetation management has the greatest potential to impact Canada lynx and lynx habitat at the project level. Given the plan components that are designed to protect the lynx and lynx habitat, there are minimal indirect effects from vegetation management. Other past, present, and reasonably foreseeable future actions that may have indirect programmatic effects are expected to be minimal as well due to the protections provided through the Endangered Species Act. Therefore, there are no expected significant cumulative effects on the Canada lynx or the habitat.

New Mexico Meadow Jumping Mouse (Zapus hudsonius luteus)

Existing Conditions and Trends

The New Mexico meadow jumping mouse (jumping mouse) is endemic to New Mexico, Arizona, and a small area of southern Colorado (Hafner et al. 1981, pp. 501–502; Jones 1999, p. 1). The species was first reviewed for listing under the Endangered Species Act in 1985 (50 CFR 37958) but was not formally listed until 2014 (78 FR 37363), with critical habitat proposed in 2013 (78 FR 37327) and designated in 2014 (79 CFR 19307).

There are currently no known occurrences of New Mexico meadow jumping mouse in the planning area; therefore, no trend information is available. The planning unit contains no current or proposed critical habitat. Additional information on New Mexico meadow jumping mouse is contained in the wildlife report in the project record.

Gunnison Sage-Grouse (Centrocercus minimus)

Existing Conditions and Trends

Historically, the range of the Gunnison sage-grouse included parts of central and southwestern Colorado, southeastern Utah, northwestern New Mexico and northeastern Arizona. Gunnison sage-grouse currently occur in seven populations in southwestern Colorado and southeastern Utah (79 FR 69312).

This species was petitioned for listing in 2001 (66 FR 54848). After multiple resubmissions of the petition, the species was found to be *not warranted* for listing in 2006 (71 FR 19954). After a status review in 2009, the species was listed as *warranted, but precluded* in 2010 (75 FR 59804). In 2013 the U.S. Fish and Wildlife Service proposed designating critical habitat for the species (78 FR 2539) and proposed listing the species as endangered (78 FR 2485). After additional review and several modified proposals, the species was eventually listed as threatened (79 FR 69191) with designated critical habitat (79 FR 69311) in 2014. In this final determination, no critical habitat was established in the planning area, although the Poncha Pass area had been considered in earlier proposals.

The Poncha Pass population is the only Gunnison sage-grouse population associated with the planning area. Delineated occupied distribution of this population covers approximately 27,747 acres, of which approximately 5,060 acres coincides with lands managed by the Forest. About 725 acres of sagebrush habitat occur on Forest lands within or near the Poncha Pass population delineation.

Poncha Pass is thought to have been part of the historical distribution of Gunnison sage-grouse. However, there were no grouse there when a population was established via transplant from 30 Gunnison Basin birds in 1971 and 1972. No population trend information was available until 1999 when the population was estimated at roughly 25 birds. In one year, the population declined to fewer than five grouse, when more grouse were brought in, again from the Gunnison Basin, in 2000 and 2001. In 2002, the population increased to slightly more than 40 grouse, but began declining in 2006, until no grouse were detected in lek surveys in the spring of 2013. Grouse were again brought in in the fall of 2013 and 2014, and six birds were counted in the Poncha Pass population during the spring 2014 lek count (79 CFR 69312); however, no subsequent evidence of reproduction was found. Therefore, the U.S. Fish and Wildlife Service concluded in 2014 that the Poncha Pass area is not a landscape capable of supporting Gunnison sage-grouse, and subsequently removed critical habitat proposed for this area from the final critical habitat determination (79 CFR 69312).

Additional information on Gunnison sage-grouse is contained in the wildlife report in the project record.

Ecological conditions for recovery, conservation, and viability

The Gunnison Sage-Grouse Rangewide Steering Committee identified the following conservation strategy elements specific to Forest Service management of lands within the Poncha Pass population (page and section references below are applicable to the *Gunnison Sage-Grouse Rangewide Conservation Plan* (Gunnison Sage-Grouse Rangewide Steering Committee 2005):

- Incorporate grazing management practices (such as those presented on page 212) for both cattle and sheep that are compatible with, or enhance, Gunnison sage-grouse habitat on federal and state lands during the permit renewal process, or when monitoring indicates need.
- Implement recommendations from rangewide strategy on “Human Infrastructure: Powerlines, Other Utility Corridors, Wind Turbines, Communication Towers, Fences, and Roads” (pg. 225).

- Implement recommendations from rangewide strategy on “Noxious and Invasive Weeds” (pg. 232).
- Implement recommendations from rangewide strategy on “Recreational Activity” (pg. 245).
- Evaluate suitability of vacant/unknown habitat classification and determine if habitat improvement techniques may enhance suitability.
- Implement timing restrictions provided in rangewide “Human Infrastructure: Powerlines, Other Utility Corridors, Wind Turbines, Communication Towers, Fences, and Roads” strategy (pg. 225), and “Oil & Gas and Mining” strategy (pg. 233).
- Implement recommendations from rangewide strategy on “Predation” (pg. 243).
- Conduct inventory of vacant/unknown habitat areas using inventory technique developed at a rangewide level (“Habitat Monitoring” strategy, pg. 220).
- Search for new or unknown existing leks utilizing survey methodology developed at rangewide level (“Habitat Monitoring” strategy, pg. 220).
- Map Gunnison sage-grouse seasonal habitats in a GIS as defined per “Habitat Monitoring” rangewide strategy, Objective 1, Strategy #7 (see pg. 220).

Direct and Indirect Effects

All action alternatives include revised management direction specific to Gunnison sage-grouse.

Under alternative A, much of the Poncha Pass area belongs to the 5.11 General Forest and Intermingled Grasslands Management Area. Alternatives B and D split the habitat, with the areas west of Highway 285 retaining the 5.11 Management Area designation, while areas east of the Highway are designated 3.6 Colorado Roadless Rule Upper Tier Management Area, and as 3 Roadless in alternative C.

Effects on Gunnison Sage-Grouse from Timber Harvest

There is little to no harvestable timber within the Poncha Pass area, or in potentially sagebrush areas in general. Revised management direction in all action alternatives does allow for occasional, irregular timber harvest in such areas but only in support of management objectives, such as habitat management. This allows timber harvest to be used as a tool (if needed) to protect or improve potential sage-grouse habitat, but prevents unnecessary harvesting activities that could damage habitat. The balance is that the timber program will cause no impact or adverse effect to the species or its habitat in the planning unit in any of the alternatives.

Effects on Gunnison Sage-Grouse from Fire Management

Revised management direction in all action alternatives ensures that the fire and fuels management programs play a large role in maintaining and restoring the natural conditions of areas, including objectives specific to existing sagebrush ecosystems, the modification of fire behavior, restoration of native plants, and creation of landscape patterns that benefit habitat.

Fire that does not accomplish or contribute toward desired conditions would be suppressed while natural ignition or planned fires that contribute to the achievement of desired conditions will be allowed. Revised management direction also allows the use of resource advisors on fires to better enable fire managers to accomplish habitat management objectives. Fuels management activities should contribute toward better management of fire with fewer high-intensity, out-of-control fires that could damage resources.

Effects on Gunnison Sage-Grouse from Livestock Grazing

Livestock grazing can have a significant influence on several key ecosystem characteristics important to the recovery, conservation, and viability of Gunnison sage-grouse. Some of these primary concerns include alteration of sagebrush characteristics and residual grass heights around potential nesting areas, and alteration of riparian zones important to brood survival. Revised management direction in all action alternatives specifically addresses range management in sage-grouse habitat, ensuring that livestock grazing is compatible with nesting and brood-rearing objectives in sage habitats and riparian areas.

Overgrazing continues to be a threat to sage-grouse habitat, but effective regulation of range practices coupled with effective monitoring as needed would help to prevent potential impacts.

In addition, revised management direction in all action alternatives prescribes to follow higher-level direction regarding species listed under the Endangered Species Act – that would include the grazing-related management practices described in the Gunnison Sage-Grouse Rangewide Conservation Plan (Gunnison Sage-Grouse Rangewide Steering Committee 2005). Grazing remains a suitable activity for Forest and neighboring lands on Poncha Pass, although any impacts would be minimal.

Effects on Gunnison Sage-Grouse from Road Construction and Reconstruction, Road Management, and Motorized Off-Highway Travel

Revised management direction in all action alternatives allows for seasonal road closures, when needed, to protect resource values. This would allow roads through sage-grouse habitat to be closed during mating season. Use of existing, designated routes will not cause further harm to current sage-grouse habitat, but may harass any remaining birds. There is a moderate chance of some adverse effect resulting from unintentional harassment by motor vehicle users and other recreationists; however, this risk is not new and was analyzed when the reintroductions were planned.

Effects on Gunnison Sage-Grouse from Trail Management, and Developed Recreation and Dispersed Recreation

Revised management direction in all action alternatives allows the forest to implement recreational closures when damage to the resource is occurring. Although somewhat reactive, it would allow for the closure of areas seasonally or year-round to recreational use if needed to protect sage-grouse or other resources. The impacts of recreation to sage-grouse were analyzed when the reintroductions were first planned, and the current plan amendment would create no additional adverse effect or negative impact.

Effects on Gunnison Sage-Grouse from Designation of Wilderness, Wild, Scenic, and Recreational Rivers, and Research Natural Areas

All action alternatives propose additional wilderness acreage in upper tier Colorado roadless acreage on Gunnison sage-grouse habitat east of Poncha Pass. This would ensure that no additional roads are constructed in the area. Designation of other areas, mostly in alternative D, would have similar impacts on road construction. This would be beneficial to the species, somewhat tempered by the fact that the Forest lands in question are on the periphery of the habitat area. As such, alternatives B, C, and D would have a minor positive impact on the species.

Effects on Gunnison Sage-Grouse from Mineral Resource Activities

A mica mine was recently proposed near Poncha Pass, but the application has been withdrawn (Gunnison Sage-Grouse Rangewide Steering Committee 2005). All action alternatives include revised management direction for abandoned mine lands and recreational dredging; neither activity is likely to occur.

Summary of Indirect Effects

Indirect effects to Gunnison sage-grouse and its habitat would be generally positive. The largest difference between the impacts of plan alternatives to Gunnison sage-grouse is that under alternatives B, C, and D, sage-grouse habitat on Forest lands east of Poncha Pass would be designated roadless (alternative C) or roadless upper tier (alternatives B and D). Recreation, range, and fire management all have some potential to cause intermittent, minor, short-term harm to the species or its habitat, but also have plan components that allow corrective action to occur. It is expected that there will be no long-term or major adverse effects or negative impacts to Gunnison sage-grouse from the proposed action under any of the alternatives.

Cumulative Effects

The most substantial current and future threats are habitat loss and decline due to human development and associated infrastructure (U.S. Fish and Wildlife Service 2014). In the Poncha Pass area, development is not considered a significant threat at this time. Habitat quality in the Poncha Pass area is also considered to be good or very good. The Gunnison Sage-Grouse Rangewide Steering Committee identified that residential development on private land is a threat specific to Gunnison sage-grouse at Poncha Pass because the area is scenic, easily accessed via Highway 285, and some interior parcels of land are in small tracts and currently for sale (Gunnison Sage-Grouse Rangewide Steering Committee 2005).

Local threats include potential impacts to habitat caused by the proximity of State Highway 285 and the electric transmission line corridor. Other threats impacting Gunnison sage-grouse to a lesser extent include overgrazing, mineral extraction, pinyon-juniper encroachment, fences, invasive plants, wildfire, large-scale water development, predation (primarily associated with human disturbance and habitat decline), and recreation. The fragmented nature of existing habitat amplifies the negative effects of these other threats (U.S. Fish and Wildlife Service 2014).

There is some threat from cumulative physical disturbances associated with recreation in the area. However, future recreation management and development would be consistent with Endangered Species Act requirements.

In addition, a mica mine was recently proposed near Poncha Pass; however, the application has since been withdrawn. The future possibility of a mine is currently not reasonably foreseeable, as there are no specific proposals or applications. Any future consideration would be included in site-specific analysis.

The cumulative effects on Gunnison sage grouse are expected to be minor and not significant due to restrictions and protections required by the Endangered Species Act.

Mexican Spotted Owl (Strix occidentalis lucida)

Existing Conditions and Trends

Distribution, Abundance, and Population Trend

The Mexican spotted owl occurs from southern Utah and Colorado south through the mountains of Arizona, New Mexico, and west Texas into the mountains of central Mexico (McDonald et al. 1991, U.S. Fish and Wildlife Service 2012). The Mexican spotted owl is widely but patchily distributed throughout its range in the United States, with distribution reflecting the availability of forested mountains and canyons, and in some cases rocky canyonlands (U.S. Fish and Wildlife Service 2013b).

The species was considered for listing under the Endangered Species Act in 1982, when the U.S. Fish and Wildlife Service found that listing the species was probably appropriate, but was precluded by lack of definitive information (47 FR 58454). In 1990 a petition was filed to list the species as threatened or endangered (55 FR 11413), resulting in a proposed rule to list the species in 1991 (56 FR 56344), followed by actual listing as threatened two years later (1993, FR 58 14248). Six months later the U.S. Fish and Wildlife Service issued a finding rejecting a petition to remove the species from the Endangered Species Act list. The ensuing years saw designation of critical habitat for the species (60 FR 29915), revocation of that critical habitat (63 FR 14378), new designation (66 FR 8530, 69 FR 53182), and development of the recovery plan (77 FR 74688).

The Forest has completed habitat and presence/absence surveys for the Mexican spotted owl since the late 1980s. Repeat surveys with current personnel have been completed in areas considered to offer the best potential habitat on the Forest. The Bureau of Land Management has also completed several years of surveys (2004–2009) in their best potential habitat. To date, no individuals have been detected on National Forest System or Bureau of Land Management lands in the San Luis Valley. Based on survey efforts, it is becoming increasingly unlikely that suitable nesting habitat for the Mexican spotted owl occurs on the Forest.

In the southern portion of the planning area, some canyons contain suitable forest vegetation types such as Douglas-fir, white fir, and ponderosa pine. However, the canyons are not typically as steep, sheer, or narrow as those described for the Wet Mountains of Colorado where Mexican spotted owls occur (Johnson 1997 cited in Ghormley 2015). Elevation may also be a limiting factor on the Forest. Although some mixed-conifer and ponderosa pine cover types on the Forest do overlap with the elevation range of owls studied in the Wet Mountains, these quickly give way to spruce-fir forest as the elevation increases (R. Ghormley, Rio Grande National Forest Wildlife Biologist, personal communication, 2015).

The species is not known to occur on the Forest or within the greater San Luis Valley area; therefore, no trends are identified for the planning area. There is no critical habitat for this species on the Forest. Additional information on the Mexican spotted owl is contained in the wildlife report in the project record.

Southwestern Willow Flycatcher (Empidonax traillii extimus)

Existing Conditions and Trends

The breeding range of the southwestern willow flycatcher includes southern California, Arizona, New Mexico, southwestern Colorado, and extreme southern portions of Nevada and Utah. Specific range boundaries are delineated in the subspecies' recovery plan (U.S. Fish and Wildlife Service 2002).

The southwestern willow flycatcher was first petitioned for listing in 1992 (57 FR 39664), proposed for listing in 1993 (58 FR 39495), and listed in 1995 (60 FR 10695). Critical habitat was designated in 1997 (62 FR 1997), although there is no critical habitat on the planning unit. Since the initial designation, there have been multiple revisions of critical habitat boundaries and the development of multiple local-level habitat conservation plans. The species is widespread, but very rare throughout its range.

Although willow flycatchers were known to occur in the San Luis Valley, little was known about the extent of their occurrence or what subspecies might be present. The current information suggests that important flycatcher habitat does occur in certain locations in the valley in association with willow-dominated riparian and wetland communities on the valley floor. Although it is recognized that the San Luis Valley occurs within a gradation zone between the *E. t. adastus* and *E. t. extimus* subspecies (Paxton et al. 2008), the U.S. Fish and Wildlife Service at this time considers all willow flycatchers in the valley to be the *E. t. extimus* subspecies (July 12, 2011, letter from the U.S. Fish and Wildlife Service to the Rio Grande National Forest).

Current information suggests that important flycatcher habitat does occur in certain locations in the San Luis Valley in association with willow-dominated riparian and wetland communities on the valley floor. Although it is recognized that the San Luis Valley occurs within a gradation zone between the *E. t. adastus* and *E. t. extimus* subspecies (Paxton et al. 2008), the U.S. Fish and Wildlife Service at this time considers all willow flycatchers in the San Luis Valley to be the *E. t. extimus* subspecies.

In 2008, the first (and only) detection of an individual willow flycatcher on the Forest occurred during surveys of adjacent Bureau of Land Management lands. This detection occurred during the early survey period (June 9, 2008) about 5 meters from the boundary of adjacent Colorado State Land Board property. No willow flycatchers have been noted in this area or in any other location on Forest lands since that time. Forest staff has conducted habitat and presence surveys for the southwestern willow flycatcher since 2003. Approximately 1,762 acres of suitable and 947 acres of potential habitat for this species have been identified on the Forest to date (2,709 acres total). Approximately 1,428 acres (81 percent) of the suitable habitat and 93 acres (10 percent) of the potential habitat has received species protocol surveys for at least two consecutive years. As of the end of the 2014 field season, mapping efforts indicate that about 81–85 percent of the potential habitat on the Forest has been evaluated (Ghormley 2015).

Due to a general lack of observations and breeding occurrence, no trend in the planning area is reported. Additional information on southwestern willow flycatcher is contained in the wildlife report in the project record.

Wolverine (Gulo gulo luscus)

The wolverine is currently listed as a proposed threatened species by the U.S. Fish and Wildlife Service. Wolverine have been historically documented on the Forest, but from 1919 until 2009 there were no confirmed sightings anywhere in Colorado, including on the Forest. In 1997 there was one sighting on the Forest, but that sighting remains in dispute.

In Colorado, nearly all historical and recent reports of wolverines are from higher-elevation, alpine areas that occur in an island-like fashion. Wolverines require large areas of suitable, high-elevation habitat. They are solitary, territorial animals and have large home ranges. In the Yellowstone region, female home ranges average more than 150 square miles and males nearly 500 square miles. Wolverines can travel large distances over extremely rough terrain and deep snow. Individual wolverines may travel more than 18 miles in one night (Colorado Parks and Wildlife 2015).

Yellow-Billed Cuckoo (Coccyzus americanus)

Existing Conditions and Trends

In the United States the range of the western yellow-billed cuckoo includes the area west of the Continental Divide, south through Montana, Wyoming, and Colorado, along the watershed divide between the upper and middle Rio Grande and Pecos Rivers in New Mexico and Texas, south to Big Bend in southwestern Texas, and extending to the states of the West Coast (79 FR 59992).

Yellow-billed cuckoo was first reviewed for potential Endangered Species Act listing as far back as 1982 (47 FR 58454). The species status underwent multiple reviews and was the subject of petitions for listing over the next several decades. In 2013 the western population of yellow-billed cuckoo was proposed to be listed as threatened (78 FR 2013). The species was formally listed as threatened in 2014 (79 FR 59991) with critical habitat designated that same year (79 FR 67154). Much of the critical habitat for the western population of the yellow-billed cuckoo overlaps with critical habitat for the southwestern willow-flycatcher.

In Colorado, yellow-billed cuckoos were historically noted as rare summer visitors, primarily on the eastern plains, but also in Middle Park and on the western slope at Grand Junction (Sclater 1912). Bailey and Niedrach (1965) considered yellow-billed cuckoos an uncommon summer resident, mainly on the eastern plains and into the Front Range, with a few breeding records from Grand County and one bird collected in Montezuma County. Thus, the few historical records suggest that the species apparently has always been rare in western Colorado, an opinion shared by Andrews and Righter (1992). Recent breeding bird atlas work in Colorado revealed only a single likely nesting record west of the Continental Divide during the 5 years of fieldwork (Wiggins 2005).

The plan area is located east of the Continental Divide but includes the San Luis Valley, where yellow-billed cuckoo occurrence has been documented. The Rocky Mountain Bird Observatory received reports of yellow-billed cuckoos from two locations in the San Luis Valley in the summer of 2008. These reports occurred along the Conejos River in Conejos County and along the Rio Grande near Del Norte in Rio Grande County (Beason 2009). The species has not been documented within the planning area. Additional information on the yellow-billed cuckoo is contained in the wildlife report in the project record.

Wildlife and Plant Species (other than TEPC/SCC)

Overview

The Forest has an assemblage of wildlife and plant species that contribute to economic and social sustainability. This section examines those wildlife and plants that are terrestrial and that are not listed as threatened, endangered, proposed, or candidate (TEPC) species; not listed as species of conservation concern (SCC); and are not aquatic. TEPC, SCC, and aquatic species are considered elsewhere in the document.

Some of the species examined in this section have some level of protection or status under Federal legislation, regulation, or Executive orders, such as the Migratory Bird Treaty Act, the Duck Stamp Act, the Bald and Golden Eagle Act, and Executive Order 13186.

The Forest has (or is likely to have) 26 species of rodents, 6 species of lagomorphs (5 rabbit/hare species and pika), 4 shrew species, 11 species of bat, 17 species in the Order Carnivora (big cats, foxes, bears, and mustelids), and 6 species of hoofed animals.

Eight native reptile or amphibian species are known to occur on the Forest. In addition, the northern leopard frog is suspected to occur, and the nonnative, invasive bullfrog is known to occur near the Forest but has not yet been detected on the Forest.

Hunting and fishing is managed and regulated by Colorado Parks and Wildlife, which also does most of the wildlife management actions that involve direct manipulation of animals, including radio-collaring, translocation, and stocking, among others. The primary management role of the Forest Service for non-TEPC wildlife is through habitat management and through cooperation with Colorado Parks and Wildlife, U.S. Fish and Wildlife Service, and other agencies and organizations. Wildlife viewing activities also occur throughout the Forest and are a primary contributor to local wildlife-related recreational pursuits.

General habitat conditions are described elsewhere in this document. This section focuses primarily upon which habitats are used by which species or groups of species and the status of the habitats in relationship to these species or groups.

In Colorado, the susceptibility of bighorn sheep to pathogens introduced by domestic sheep is regarded as the primary factor limiting bighorn sheep populations (George et al. 2009). As of 2010, there were about 11,700 domestic sheep permitted to graze on 26 established allotments on the Rio Grande National Forest. As a result of risk assessments of disease transmission between domestic and bighorn sheep at the project level, at least 13 of these allotments have been vacated since that time (USDA Forest Service 2006, 2010a, 2013).

Local habitat relationships for bighorn sheep are similar to those described elsewhere for Colorado (George et al. 2009). Most local bighorn sheep populations occur in steep, mountainous terrain in the alpine and subalpine zones. The overall components of bighorn sheep range include summer, winter, severe winter, and concentration areas, as well as migration routes. These components are found in various locations throughout the Forest, depending on the herds involved. Most herds display elevational migrations that vary by season, although some herds remain in the alpine zone throughout the year. The protection of winter range areas can be particularly important for bighorn sheep. Most winter range areas are characterized by low snow depth and wind-swept areas with sufficient forage and adjacent escape terrain for eluding predators (Krausman and Bowyer 2003). In some areas, bighorn sheep may remain at or move to high-elevation, wind-swept ridges to avoid heavy snow depths at lower elevations. Lambing areas on the Forest are typically on or very close to traditional winter range. They tend to be used on an annual basis by the same maternal group and are sensitive to disturbances. Important bighorn sheep lambing areas are located on all ranger districts of the Forest, as well as on local Bureau of Land Management lands.

Domestic sheep numbers on the Forest have declined significantly since the peak periods of the late 1800s and early 1900s. However, the potential contact and disease transmission issue is unique among wildlife-related issues on the Forest in that it may take only one contact by one domestic sheep to spread respiratory illness throughout and among bighorn sheep herds. Therefore, despite the reduction in permitted domestic sheep numbers, the role that domestic sheep may play in influencing the long-term persistence of local bighorn sheep populations on the Forest remains an important management focus.

Local information in the bighorn sheep conservation assessment (USDA Forest Service 2010b) for the Forest suggests that recreational pack goats could also be a management concern in certain areas. Currently, the primary area of concern for pack goats involves the Sangre de Cristo mountain range, especially around Willow Lake Basin. In this particular location, bighorn sheep are accustomed and attracted to recreationists camping and passing through on their way to climbing peaks. Frequent contact and close association with camps and camping equipment in this location indicate that a high risk of intermingling and potential contact is likely if pack goats are involved. Furthermore, the bighorn sheep herds in this area are considered to be secure and are a conservation priority for Colorado.

Affected Environment, Existing Conditions, and Trends

Habitat Connectivity

Habitat connectivity can be viewed as the degree to which landscapes facilitate or impede the movement of species and ecological processes among suitable habitat patches (Taylor et al. 1993). Alternatively, connectivity may be a continuous property of the landscape, independent of habitat patches and pathways (Fischer et al. 2004). Habitat connectivity involves both structural connectivity (the physical arrangements of landscape disturbance and/or habitat patches) and functional connectivity (the movement of individuals across areas of disturbance and/or among patches). Functional connectivity is both species- and landscape-specific (Tischendorf et al. 2000). Distinguishing between the two types of connectivity is important because structural connectivity does not necessarily imply functional connectivity. The degree to which a landscape is connected determines the amount of dispersal there is among patches, which influences gene flow, local adaptation, extinction risk, colonization probability, and the potential for animals to move as they cope with uncertainties such as climate change (Hodgson et al. 2009). In some landscapes, highways and major roads are commonly identified as a primary barrier to functional habitat connectivity.

Measurements for habitat connectivity on the Forest involve both the physical attributes that might provide barriers to movement, such as roads and trails, and the vegetative or habitat structural changes and patterns that influence the ability of species to move across the landscape. Potential impacts from impaired connectivity can vary from one species to the next depending upon the characteristics of each species.

In general, habitat connectivity is more of a continuous property of landscape vegetation conditions and patterns then it is of habitat patches and pathways. For the most part, the Forest is bounded on all sides by adjacent public lands and landscape patterns that add to the continuous nature of the landscape. For some wildlife species, such as Rocky Mountain elk, mule deer, and other game species, these landscape conditions continue to facilitate historic movement patterns within and among national forests, tribal lands, and other public and private lands including across state lines. Known habitat connectivity features on or overlapping the Forest include migration and dispersal corridors, daily home range movement, and broader landscape linkage areas that facilitate movement of multiple species and ecological processes. An estimated 50 percent of the landscape that occurs as designated wilderness or backcountry contributes to habitat connectivity and movement patterns for many species, particularly species sensitive to human disturbances. Additional protected areas, including special interest areas, research natural areas, wild, scenic, and recreational river corridors, and other areas increase the contribution to habitat connectivity across the landscape. Additional protected areas occur on adjacent National Forest System lands as well as across state and administrative boundaries.

The vegetative characteristics of mid- to lower-elevation ecosystems present more mosaic landscape patterns associated with natural openings and habitat patches. Species associated with these ecosystems have evolved with these characteristics and are therefore less sensitive to landscape patterns associated with created openings. In these systems, alteration of the disturbance regime that maintains these landscape patterns can lead to dense vegetation that creates potential movement barriers for some species. Higher-elevation ecosystem types, such as in spruce-fir ecosystems, are more homogenous where small-scale disturbance patterns may dominate for long periods of time until conditions support a large-scale wildfire (Veblen et al. 1991b, Bebi et al. 2003). Some species that are sensitive to openings and other landscape characteristics, such as Canada lynx and American marten, are more closely associated with these conditions. However, a current spruce beetle outbreak is associated with extensive mortality of overstory trees on the spruce-fir landscape, resulting in canopy conditions that are several times more open than what typically exists for very long periods of time. This has affected habitat structure, species composition, and other landscape patterns associated with structural habitat connectivity. The consequences of this to functional habitat connectivity remains uncertain. What is known, however, is that standing dead trees and log complexes, remaining green tree patches, understory regeneration patches, and other legacy features within the forest matrix are key attributes that help establish refugia for various species groups and likely help facilitate habitat connectivity in these conditions (Martin et al. 2006).

Highways and primary roads are also a likely factor that contributes to habitat fragmentation for some species in certain locations, particularly mid- to lower-elevation ecosystem types associated with more open conditions and gentle topography. Native-surface National Forest System roads add to these effects to a lesser extent but may still be important for amphibian and reptile species. Some species, such as various songbirds, are displaced from habitats along open roads. How frequently and to what degree existing road systems contribute to barriers for various species locally is generally unknown; however, potential impacts are likely more pronounced with motorized vehicles than with other modes of transportation. Highway-related mortality of sensitive species such as Canada lynx has been documented locally. Currently, there are four designated linkage areas that occur on, or overlap the plan area. These are broader areas of connectivity intended to help facilitate movement across barriers such as roads and highways, and were designed primarily with Canada lynx in mind. Information specific to wildlife movements in two of these linkage areas has been collected, with one these areas (North Pass lynx linkage area) considered a key movement zone to and from the core habitat area of southwest Colorado to the remainder of the state.

Direct and Indirect Effects

In general, all action alternatives provide for habitat connectivity in a similar manner as they all address structural connectivity considerations such as physical barriers to movement as well as functional connectivity considerations associated with landscape vegetation characteristics and land-use designations. Some habitat connectivity considerations are also associated with certain ecosystem types and are species-specific; however, benefits to other species should be expected as well in many cases. For example, all action alternatives incorporate the existing management direction from the Southern Rockies Lynx Amendment that are specific to Canada lynx. These plan components would address structural connectivity considerations such as potential movement barriers across major highways and roads, road development and placement, and human uses that might contribute to habitat fragmentation, such as development or expansion of recreational facilities, ski areas, road locations, and over-snow motorized travel. In a similar manner, all action alternatives also incorporate the four existing lynx linkage areas from the Southern Rockies Lynx Amendment, ensuring that a management focus will be retained along major highways known or considered to be important crossing locations for wildlife.

All action alternatives include additional plan components associated with potential physical impediments to habitat connectivity. This updated plan direction encourages working with partners to improve habitat connectivity across highways. It also encourages evaluation and updates to existing linkage areas, if needed, as well as specifically addressing maintenance of habitat connectivity in association with winter recreational activities.

In regards to functional habitat connectivity, the primary difference between the action alternatives involves the amount of managed versus protected lands in each alternative, and differences in management guidance that facilitate landscape connectivity considerations. At a broad scale, alternative D likely provides the highest potential for maintenance of landscape characteristics important to functional habitat connectivity because it provides for about 200,000 acres more of protected area (e.g., designated wilderness) and fewer general forest acres that might be associated with management activities, roads, and other features that might affect structural habitat connectivity and impede movement across landscapes by some species. For the same reasons, alternative B likely provides the next best scenario for facilitating habitat connectivity while alternative C likely provides for the least amount of potential for maintaining habitat connectivity. However, it should be noted that alternative D is associated with about 258,000 fewer acres of roadless designations than alternative B. Therefore, both alternatives may be similar as there are likely only slight differences regarding functional habitat connectivity in regards to wilderness or roadless designations. Alternative C, however, provides for no increase in wilderness acres over the existing condition (alternative A) and an increase in managed lands so therefore would likely provide less potential for habitat connectivity.

All action alternatives also incorporate the Southern Rockies Lynx Amendment management direction to provide for connectivity for Canada lynx within and among lynx home range areas. Because of the existing condition, the capability of the landscape to provide suitable habitat for all associated species in a manner that occurs in a green forest condition is unlikely. Currently, occupancy by some avian and small mammal species is known to be declining (Ivan 2017, Pavlacky and Sparks 2016). While it is likely that movement and linkage areas still exist within the forest matrix, particularly where associated with important landscape features such as riparian zones or traditional movement areas, uncertainty exists regarding how such an extensive landscape change may or may not be influencing functional habitat connectivity.

Additional plan components, some specifically for the spruce-fir zone and at-risk species such as Canada lynx, were developed that emphasize habitat connectivity provisions for various species at various spatial scales and the importance of structural legacies such as snags in maintaining connectivity in the changed condition. Plan direction in all action alternatives addresses habitat connectivity in all forest ecosystem types, minimizes disturbances in areas with connectivity, addresses the maintenance of seasonal wildlife movement areas identified and defined by Colorado Parks and Wildlife, and encourages the use of biological legacies such as snags and downed logs as building blocks for connectivity at various spatial scales. Plan direction also addresses potential habitat connectivity needs at the project level, including 1) assessing habitat connectivity conditions based on sub-watershed scales, 2) providing for appropriate distance considerations for designing movement areas in existing riparian zones, and 3) design considerations for travel along topographic features known to facilitate movement across landscapes.

Alternatives B and D also include a standard specific to lynx (S-LYNX-7) that provides additional guidance for minimizing potential influences in habitat conditions believed to represent quality habitat for the species. While not specific to habitat connectivity, the standard does address maintenance of conditions expected to contribute to habitat connectivity across the landscape. This standard is not included in alternative C.

It should be noted that all of the above conclusions are based on a broadscale evaluation of the action alternatives. At a broad scale, all action alternatives are expected to maintain or facilitate landscape characteristics that promote habitat connectivity. However, it is likely that site-specific factors such as existing site conditions, adjacency considerations, and scale, location, and intensity of proposed management actions, will also have important outcomes on whether certain activities impede or facilitate habitat connectivity at a more local scale.

How the management activities incorporate known or suspected movement criteria for the key species of interest in various ecosystem types will also be important to this outcome (Mönkkönen and Reunanen 1999).

Birds

Migratory birds: Since 2011, The Bird Conservancy of the Rockies has detected 122 species of birds on the Forest; Forest Service records (dating back much further) show 174 species (Bird Conservancy of the Rockies 2017). Regular surveys are conducted by the Bird Conservancy of the Rockies that include mist-netting and banding as well as visual and auditory sightings.

Raptors: Raptors detected by the Bird Conservancy of the Rockies include red-tailed hawk, northern goshawk, great-horned owl, golden eagle, Cooper's hawk, American kestrel, turkey vulture, Swainson's hawk, sharp-shinned hawk, osprey, and northern pygmy owl (Bird Conservancy of the Rockies 2017). In addition, the Forest Service has records of bald eagle (USDA Forest Service 2015). As a group, raptor species are generally dependent upon large trees (both live and snags) or cliffs for nesting, and require prey species. Different species of raptors prefer different environments for hunting. Some species, such as red-tailed hawk, hunt over open terrain, while others, such as great-horned owl, can hunt in less open areas, including areas with extensive forest canopy. Most species primarily seek terrestrial mammals as prey and may also scavenge food—the exceptions being the osprey and bald eagle, which depend upon fish for much of their diets, and the turkey vulture, which is almost exclusively a scavenger.

In general, large trees and snags are important factors in the management of raptors because they serve as nesting platforms, or in the case of northern pygmy owls, they commonly contain cavities for nesting. Large trees and snags also provide perches from which raptors can scan for prey while resting.

Disturbance during nesting season can cause raptors to abandon nests and generally decreases nesting success, although some individuals can become accustomed to activity.

Wetland birds: Waterfowl, wading birds, and other birds strongly associated with water and detected by the Bird Conservancy of the Rockies on the Forest since 2011 include American dipper, snowy egret, great blue heron, grebe species, bank swallow, belted kingfisher, Canada goose, common merganser, mallard, and other duck and teal species (Bird Conservancy of the Rockies 2017). The nearby San Luis Valley has many well-known wetland birding hotspots, but many of the species common on the valley floor appear to not make it to the reservoirs and riparian areas in or adjacent to the Forest (eBird 2017a).

Demand Species

Game Species: Mule deer, moose, elk, pronghorn, Rocky Mountain bighorn sheep, mountain lion, and bear are present, with hunting licenses for these species issued by Colorado Parks and Wildlife. The Forest provides valuable habitat for a number of game species, large and small.

Colorado Parks and Wildlife organizes hunting licensing and management through designation of game management units (GMU), which are the same for most large game species, and data analysis units (DAU), which vary from species to species and are created by lumping together game management units. Deer/elk GMUs 68, 681, 76, 79, 80, 81, and 82 overlap all with all Forest lands in the planning area. Colorado Parks and Wildlife staff estimates game populations in those areas based upon data analysis units, which roughly approximate discrete herds (Colorado Parks and Wildlife 2016a, b).

Deer and elk have the same data analysis units:

- DAU 26 includes GMUs 68, 681, and 682,
- DAU 35 includes GMU 80 and 81,
- DAU 36 includes GMUs 76, 79, and 791, and
- DAU 37 includes GMU 82.

These game management units and data analysis units are not limited to Forest lands; some of the game management units listed above contain no Forest lands (all of the listed data analysis units have at least some overlap with the planning unit). Colorado Parks and Wildlife population estimates for those areas provide insight into population numbers on the Forest and are influenced by Forest management actions—but these numbers do not reflect the actual number of mule deer and elk on the Forest, but instead reflect a much wider area. Population estimates of mule deer and elk for 2015 for four of the data analysis units that overlap with the plan area are listed in Table 54.

Table 54. Population estimates of mule deer and elk for 2015

[DAU, data analysis unit. Estimates provided by Colorado Parks and Wildlife (2016 a, b).]

Species	DAU 26	DAU 35	DAU 36	DAU 37
Mule Deer	4,450	4,830	1,680	1,820
Elk	3,060	6,010	(null)	(null)

The data analysis units for moose are much larger: Moose DAU 4 contains GMUs 65, 66, 67, 68, 74, 75, 76, 77, 79, 681, and 751. This area includes most of the northwestern part of the Rio Grande National Forest as well as most of the San Juan National Forest. Colorado Parks and Wildlife staff estimated 450 moose in the data analysis unit for 2015 (Colorado Parks and Wildlife 2016c).

Most Rocky Mountain bighorn sheep herds on the Forest do not have established DAU plans and are therefore managed primarily by GMU boundaries and populations. Current populations and status of bighorn sheep herds on the Forest are described in Table 55.

Table 55. Current status of Rocky Mountain Bighorn Sheep on the Rio Grande National Forest

Herd Number and Name	Current Estimate (2016)	DAU	Status
S8 - Huerfano	80	N/A	Considered Secure
S9- Sangre de Cristo	300	N/A	Potential Tier 1 – Considered Secure
S10 - Trickle Mountain	35	N/A	Disease – Stagnant/Decreasing
S15-Sheep Mountain	200	RBS 20	Tier 1 – Considered Secure
S22 - San Luis Peak	80	RBS 22	Tier 2 – Disease/Potential Recovery
S29-Alamosa Canyon	30	N/A	Tier 2 – Disease- Stagnant/Decreasing
S30- Conejos Canyon	60	N/A	Tier 2 – Disease- Stable to decreasing
S33-Pole Creek	135	N/A	Historic Disease – Secure but vulnerable
S36-Bellows Creek	80	RBS 22	Tier 2 – Disease/Potential Recovery
S53-Bristol Head	80	RBS 22	Tier 2 – Disease/Potential Recovery
S55-Natural Arch/ Carnero Creek	15	N/A	Disease – Stagnant/Decreasing
Summary	1,095		3–4 herds considered secure

As of 2016, there were 11 bighorn sheep GMUs that occur or partially occur on the Forest that support approximately 1,095 individuals. Two other GMUs, Cimarrona Peak (S16) and Cotopaxi (S68) also border or slightly overlap the Forest but are not included in this analysis because they primarily occur on adjacent lands. Two DAUs representing interconnected populations have been established for bighorn sheep on the Forest (RBS-20, RBS-22), with an additional being considered (RBS-24). DAU-RBS-20 (Weminuche Population) involves GMU S-15 on the Rio Grande National Forest and S-S16 (Cimarrona Peak), and S28 (Vallecito Herd) on the San Juan National Forest. DAU 22 (Central San Juan Population) includes GMUs S22, S36, and S53 on the Rio Grande National Forest (Table 56) and S52 (Rock Creek) on the Grand Mesa, Uncompahgre, and Gunnison National Forests. Proposed DAU 24 (South San Juan Population) would involve GMU S29 and S30 on the Rio Grande National Forest and S31 (Blanca Peak) on the San Juan National Forest. The population structure of the DAUs demonstrates that many bighorn sheep herds on the Forest overlap and interact with herds on adjacent land ownerships. Several GMUs also overlap with adjacent National Forest System or Bureau of Land Management lands, as well as State and private lands.

Chronic wasting disease has not been detected in any ungulate population association with the Forest. It is important to continue interagency efforts to prevent chronic wasting disease and other wildlife diseases.

Table 56. Population estimates for Rocky Mountain bighorn sheep in DAU 22

[Estimates provided by Colorado Parks and Wildlife (2017b).]

Game Management Unit	2014	2015	2016
S22, San Luis Peak	60	60	80
S36, Bellows Creek	50	50	80
S53, Bristol Head	115	115	80

Colorado Parks and Wildlife does not estimate population numbers annually for black bear or mountain lion, but does track harvest numbers by game management unit (Table 57).

Table 57. Black bear harvest numbers in game management units that overlap with the Forest

[Source: Colorado Parks and Wildlife (2017c, 2016d)

Game Management Unit	2016 Black Bear Harvest	2014 Mountain Lion Harvest
68	1	2
681	(null)	4
76	5	4
79	1	1
80	3	6
81	9	4
82	2	5

In addition, small game hunting occurs on the Forest, although Colorado Parks and Wildlife does not estimate population numbers for most species (other than bobcat, which is only estimated per each quarter of the state) and does not track harvest numbers for all species. Small game hunting can include the use of firearms or bows, but also includes trapping and falconry. Methods and regulations vary from species to species, and depend also upon harvest method (firearm, bow, trap, or raptor). Species available for small game harvest include furbearers (weasel and fox species), rabbit species, prairie dogs, beaver, some squirrel species, marmot, bobcat, some sage-grouse species, quail, grouse, pheasant, snipe, rail and other species. Some bird species may only be hunted with hawks and falcons.

Colorado Parks and Wildlife staff have identified the need to better monitor the numbers of some species, especially bobcat. Other species have population estimates and other data and analysis developed independent of the hunting program. This is particularly true for bird species and some mammal species that are primary prey sources for raptors; such bird and prey species are monitored by the Bird Conservancy of the Rockies.

<u>Medicinal Plants</u>: Oshá (*Ligusticum porteri*) is a perennial plant in the carrot family (Apiaceae) that is harvested for its roots. The roots are used in traditional medicines by Native Americans, Hispanics, and other individuals to treat various respiratory ailments. Both commercial and personal harvest of oshá take place on the Forest. Oshá is commonly associated with aspen and mixed conifer forests and montane meadows ranging from 6,000 to 11,700 feet in elevation in Colorado. Oshá can be a common component of the understory

of these forests and meadows or can occur solitary. Oshá is considered an indicator of healthy rangelands in some ecosystems.

Recent research (Kindscher et al. 2017) regarding oshá on the San Juan National Forest has demonstrated that, in general, the below- and above-ground productivity of oshá increases with decreasing forest canopy cover. Given that much of the spruce-fir forests of the Forest have been or are currently being impacted by insects, it is likely that oshá habitat is expanding and likely improving in quality at present in response to the decrease in canopy cover after the trees die. These forests will, with time, re-establish, and the canopy will begin to close. If the findings of Kindscher et al. (2017) hold true, then the quantity and quality of oshá habitat on the Forest will eventually decline.

The current demand for oshá from across its range (Arizona, Colorado, Idaho, New Mexico, Nevada, Utah, and Wyoming, as well as into Sonora and Chihuahua in Mexico) is estimated to be about 1,000–2,000 kg per year with the price ranging from $70 to $420/kg (Kindscher et al. 2017). What proportion of this harvest is from the Forest is not known, because it is the proportion of that harvest that is accounted for by individuals and tribes as opposed to commercial harvest. Because cultivation of oshá is not currently feasible, the entire supply of oshá is wild harvested. Because much of the oshá habitat in the Western United States is on National Forest System lands, it stands to reason that much of the wild harvest comes from National Forest System lands. Although permit procedures are in place, they vary by National Forest System unit. Because oshá, like any other medicinal plant that grows on National Forest System lands, is considered a non-timber forest product, it is subject to the permitting process thereof.

Although the absolute sustainability of wild harvesting oshá from National Forest System lands and the Rio Grande National Forest in particular is unclear, oshá does re-establish itself in the pits were roots have been harvested, which is uncommon for a medicinally important plant. However, Kindscher et al. (2017) demonstrated that roots that re-establish are smaller than roots that are removed, and that the productivity of the re-established plants is influenced by canopy cover, whereas pits with less canopy cover had more re-establishment.

Other Species of Interest

Northern leopard frog was historically present on the planning unit, but has not been documented there since 1997 despite species-targeted surveys. Range contractions and localized extinctions have occurred in Colorado (Hammerson 1982, Corn and Fogleman 1984, Cousineau and Rogers 1991, Smith and Keinath 2007). The species is considered to be declining in the State of Colorado (Smith and Keinath 2007).

During development of Assessment 5, the Forest considered the northern leopard frog for inclusion as a species of conservation concern but instead excluded it because the species appears to not currently occur in the planning unit. In all other respects, the species appears to merit inclusion as a species of conservation concern. Lack of occurrence in the planning unit is the only reason the species is not a species of conservation concern.

Direct and Indirect Effects

All action alternatives include revised management direction for fish, wildlife, and plant species. Timber harvesting, roads and trails, and recreation all have the potential to impact fish, wildlife and plant species.

Effects on Wildlife and Plant Species from Vegetation Management

Timber harvest has potential to impact plant and animal species, especially raptors and cavity-nesting species. This would include the removal of large trees and snags that are critical to raptors. Alternatives B, C, and D include plan direction that protects snags, large trees, and mature vegetation, including guidelines adopted from Colorado Parks and Wildlife guidance. This includes some components specifically developed to be protective of raptors, as well as focused plan components developed for Canada lynx that incidentally protect other species.

Current and proposed management activities would have little impact on wetland birds. Riparian areas in the planning unit are protected through application of revised management direction in all action alternatives that specifically address the impacts of timber harvesting activities to wetland environments.

Timber harvesting and management have the potential to impact demand species as well, with the effects varying from species to species. Mule deer are habitat generalists and benefit from a mix of open and forested terrain. Forested areas provide cover, while edge habitats and open terrain provide better forage. Timber program plan components encourage a mix of habitats; this would be expected to be beneficial to mule deer.

Elk prefer more open habitat than mule deer but will still make use of forested areas for cover and concealment. Vegetation management direction in all alternatives would have effects to elk habitat depending on the location.

Bighorn sheep may be influenced by vegetation management. This primarily involves the use of prescribed fire and thinning.

Small game impacts from timber harvesting could include destruction of dens or burrows, loss of cover, loss of forage or cover for prey species, and unintentional harassment. “Small game” encompasses a wide variety of species with a wide variety of habitat needs, generally similar to the needs of fish, wildlife, and plants in general.

Timber harvest and salvage would have a moderate but short-term impact on oshá because the plant benefits from more open forest conditions.

All action alternatives include revised plan components that are protective of fish, wildlife, and plants in general that would also benefit small game species and influence timber harvesting techniques in a way that would make such activities less damaging.

Alternatives B and D would have Management Area 1.1a – Recommended Wilderness in addition to currently designated wilderness. Alternatives A and C would have only the currently designated wilderness. Most of the area proposed for designation 1.1a are already currently designated as roadless. Those areas that would be designated 1.1a would likely experience less timber harvest than if they did not have that classification.

Alternative D has the largest combination of wilderness and recommended wilderness, which would be protective of plant and animal species due to reduced timber harvest. Alternative B also has some recommended wilderness, but less than alternative D. Alternatives A and C each have essentially the same amount of wilderness.

Overall, the impacts of timber harvesting to wildlife and plants would have a variety of effects, moderate to minor, depending on factors such as location, scale, intensity, and the application of protective plan components, which are incorporated across all action alternatives.

Effects on Wildlife and Plant Species from Fire Management

All action alternatives include fire management plan direction and fire management zones focused on returning or maintaining the plan area within the natural range of variability for fire-related effects, which would be generally beneficial to native species. Benefits would be most pronounced for species whose habitat relationships are more closely associated with fire-adapted ecosystems at low to mid-elevation. Examples of these species include Rocky Mountain bighorn sheep, mule deer, pronghorn, Rocky Mountain elk, and various other game species. Negative effects may be associated with species associated with spruce-fir ecosystems and other high-elevation habitat types with long fire-return intervals. These effects are likely to be more closely associated with factors such as fire size, severity, burn patterns, and other factors.

Alternative A currently does not allow naturally ignited fires to burn for resource benefit in most management areas. All action alternatives allow naturally ignited wildfires to burn to meet resource objectives, dependent on management area status and environmental conditions at the time of ignition. Therefore, alternatives B, C, and D have a better chance of moving toward or maintaining the natural range of variability for the different vegetation types within the planning area.

The overall impact of fire management activities will likely benefit native plant and animal species. This impact may be slightly greater for alternatives B, C, and D than for alternative A.

Effects on Wildlife and Plant Species from Livestock Grazing

Livestock grazing can impact wildlife and plant species in many ways. Cattle prefer grass instead of forbs, and at moderate levels, this can stimulate grass to grow faster, giving grass a competitive advantage over forbs. At higher levels of grazing, the removal of live plant matter can cause erosion. Bare soil produced by such overgrazing can be at risk to colonization by invasive plants. At high use levels, trampling can lead to the loss of soil cohesion and erosion, impacting aquatic species even if there is no grazing in riparian areas. Grazing in riparian areas can have negative impacts to species that depend upon such areas, even at relatively low use rates.

Cattle compete with native wildlife for forage. Although cattle prefer grass and native deer prefer browse, elk also prefer grass and there is still dietary overlap.

All action alternatives contain updated deer and elk/bighorn sheep/big game winter range management areas that include a number of protective measures for deer, elk, and where applicable, bighorn sheep, including measures to ensure adequate forage and consideration of wildlife needs in the development of grazing strategies. Drought may exacerbate this concern on winter range areas. The maintenance of high-quality forage resources is also a concern for elk and other big game species during severe winters when the animals are concentrated on limited range areas as mapped by Colorado Parks and Wildlife. Specific to bighorn sheep, all action alternatives include revised management direction to help minimize or prevent the risk of potential contact between bighorn sheep and domestic sheep and help address the separation objectives when ranges for the two species occur in proximity. Currently, many but not all of the existing bighorn sheep herds have been assessed for potential movements within and beyond their core herd home range in relationship to domestic sheep allotments and other bighorn sheep herds, including movements onto adjacent administrative units and state and private lands. Individual bighorn sheep on the Forest have demonstrated straight-line movements of more than 20 miles, including movements to and from the San Juan National Forest and the Grand Mesa, Uncompahgre, and Gunnison National Forests. Alternatives B and D address the risk of potential contact between recreational pack goats in the Sangre de Cristo range by prohibiting pack goat use in this location. This is expected to significantly reduce this issue in the only location it is known. Alternative C does not include this prohibition and continues this risk. Recreational pack goat use is not prohibited in any other location on the Forest under any action alternative. Although pack goat use may occur in other bighorn sheep range, the risk of contact is considered low in these locations with no known potential issues. Revised plan direction in all action alternatives provides for educational signing regarding pack goats and bighorn sheep in other locations on the Forest.

There is no difference among alternatives in terms of total permitted animal unit months. Where that grazing will specifically occur would vary in alternative D, based on the potential designation of special interest areas and/or research natural areas that do not allow for ongoing livestock grazing.

Because the total number of animal unit months does not vary across alternatives, impacts to big game are expected to be somewhat limited as adequate forage resources are expected to remain available over most big game range areas.

Effects on Wildlife and Plant Species from Road Construction, Reconstruction, and Management

Roads can impact native plants and animals in many ways. Roads can bisect habitat, fragmenting a species' population. Roads can contribute to erosion and alter drainage patterns. Direct mortality of wildlife can occur from roadkill. Some species are tolerant of noise and motion from nearby roads, but many animal species will not nest or den near roads, in which case the very presence of roads can significantly reduce the amount of habitat available for the species to use. The width of road corridors, along with the type of use those roads receive, both affect the impact such a road can have on wildlife connectivity and fragmentation.

As road management level increases, fragmentation-related impacts also are expected to increase due to the greater width—i.e., narrow, off-highway vehicle trails would generally have less impact that wider general-purpose roads. In addition to width, traffic speed and frequency can also influence how wildlife perceive the road and therefore how much of a barrier the road may be to habitat connectivity. A level 2 road with frequent use by loud, high-speed, off-highway vehicles may have a greater impact to wildlife and connectivity than a level 3 road that receives only limited use by relatively slow and quiet sport utility vehicles, even if the level 3 road is wider and more visible.

Road maintenance can introduce invasive species through the presence of seeds unknowingly contained in fill material, or embedded in dirt or mud stuck to construction equipment brought in from off-site. Nonnative and invasive seeds have at times been used intentionally as erosion control or for revegetation. Seed mixes (even native seed mixes) used for revegetation after road projects can lure wildlife closer to roads and increase the risk of roadkill.

Vehicle use can introduce toxins into the environment, from exhaust gases to leaked fluids such as anti-freeze, oil, and grease; this could come from regular use of the roads as well as maintenance activities on equipment. In some soil types, dust from the road can coat nearby plant leaves enough to limit photosynthesis.

Road corridors tend to be the most likely place for unplanned human ignition fires to start. This could be from arson, vehicle accidents, sparks created by poorly maintained vehicles, or any of a variety of other causes, intentional or not.

In a more indirect way, roads can experience significant impacts simply by being a means of allowing visitor access, which brings with it all of the impacts that visitors cause.

Because this is not a travel management plan, significant changes are not expected from this plan revision. The road network and use thereof on the Forest has a moderate adverse impact to the fish, wildlife, and plant species on the Forest. This occurs primarily via habitat fragmentation, erosion, roadkill, and harassment. Because this scale of the road network does not vary across alternatives, impacts would not vary across alternatives.

Effects on Wildlife and Plant Species from Motorized Off-Highway Travel

Off-highway vehicle traffic can harm wildlife many different ways, from the existence of off-highway vehicle trails and physical impacts as well as from noise and other factors. Off-highway vehicle trails or National Forest System Road management level 2 roads can contribute to habitat fragmentation and increased edge effects, although the effect of off-highway vehicle trails is far less pronounced than that of the wider, more built-up roads used by more regular street vehicles (National Forest System Road management levels 3, 4, 5 or equivalent).

Illegal off-route travel by off-highway vehicles continues to be a problem on the Forest, as well as on many other federal lands. Most of this occurs in the form of short-distance loops or spurs off existing routes, especially in riparian areas. These have the same impacts as those of planned routes and may have additional, more severe, impacts due to their unplanned nature.

Similar to the impact of the road network, alternatives in the plan have little impact on the use of off-highway vehicles other than minor protective measures available to close certain areas if necessary to protect at-risk species, or due to adverse environmental damage. The minor to moderate impact of off-highway vehicle use to fish, wildlife, and plants would continue, and would likely remain the same for all alternatives.

Effects on Wildlife and Plant Species from Trail Management

Trail impacts can roughly be divided into two categories: physical impacts of the trails themselves, and the effects of the use of those trails.

Physical impacts of trails are similar to impacts of roads, but on a smaller scale. Alteration from erosion, channeling, and drainage can all occur due to the presence of trails. Trail maintenance can still bring in nonnative plant species if equipment is not cleaned prior to use, because a weed seed in mud stuck to a shovel is just as viable as a weed seed in mud stuck to a road grader. Multiple plan components are designed to reduce or eliminate these sorts of impacts. A trail that is properly designed for the terrain and use it receives will have little direct impact to its environment, other than the impacts caused by the humans who use it.

Trails also allow and encourage visitor access. This can have a variety of impacts, which are addressed in the *Sustainable Recreation* section.

Some Forestwide plan components could cause an expansion of the existing trail network by encouraging trail connections between existing National Forest System trails and strategic community areas and encouraging the use of loop trails. Although these components could cause the trail network to expand, most of that expansion would be in the form of short trail segments that connect currently existing trails. As previously stated, these trails should have very little impact other than impacts caused by visitor use.

These impacts are expected to be minor, and would not vary from one alternative to the next.

Effects on Wildlife and Plant Species from Developed Recreation

Visitor use typically has a larger impact than trail construction or management. This includes noise that leads to harassment of wildlife, intentional or unintentional. Dogs that accompany hikers can add to the harassment of wildlife, and even leashed dogs can have an impact as they look and smell like the predators that many wildlife species have evolved to see as threats. Trails can allow visitors to unintentionally introduce weed seeds (from boots or pets) into otherwise pristine environments. Wildlife may consume trash that visitors leave behind, leading to ill effects. Visitors may drop food accidentally or intentionally feed wildlife, leading to larger numbers of rodents or “camp robber” bird species such as jays, magpies, and ravens.

Some Forestwide plan components could reduce the impacts that developed and dispersed recreation have on the plant and animal species in the planning unit. Revised plan direction in all action alternatives allows for the closure of campgrounds if the level of use drops below a threshold, allowing a potential for some areas to be restored back to a more natural setting. Revised plan direction also allows for closures of some areas if use levels exceed the site’s capacity enough to cause environmental damage or if the type of use causes unacceptable environmental damage.

Alternatives A, B, and D contain Management Area 4.3 – Dispersed and Developed Recreation. In alternative C, Management Area 4.3 is included in Management Area 5, General Forests and Rangelands. Management Area 4.3 is largest in alternative B (101,218 acres) and smallest in alternative D (73,053 acres), with alternative A part-way between the two (92,947 acres). This should roughly correspond to the impacts of those alternatives, other than alternative C, which probably has a wider range of potential impacts.

Overall, the environmental impact from developed recreation would be the least with alternative D, slightly greater with A, and greater yet with B, while alternative C could have impacts anywhere from slightly less than alternative D to slightly greater than alternative B. Overall these impacts would be expected to range from negligible to moderate, depending on the implementation of Forestwide plan components and the project-level planning associated with their use and development.

Effects on Wildlife and Plant Species from Dispersed Recreation

Effects from dispersed recreation are very similar to effects from developed recreation, but at a much lower intensity. Conversely, these impacts can be more widespread and can occur in environments that are otherwise relatively pristine. Noise from visitors can harass wildlife. Dogs that accompany hikers can add to the harassment of wildlife. Trails can allow visitors to unintentionally introduce weed seeds into otherwise pristine environments. Use of soaps and detergents associated with camping can contaminate streams. Dispersed camping areas can experience soil compaction, and dispersed camping activities can cause unintentional wildlife harassment.

Impacts from dispersed recreation are expected to mirror those from developed recreation, with two exceptions. Impacts from dispersed recreation would be expected to be at a much lower intensity than those from developed recreation because the visitors would be more widely spread out. However, this less-intense impact could be spread out over a much wider area.

Dispersed are the same as developed in terms of which alternatives have which impact.

Effects on Wildlife and Plant Species from Designation of Wilderness, Wild, Scenic, and Recreational Rivers, Special Interest Areas, and Research Natural Areas

Wilderness designation is mostly protective of natural resources. This designation can, however, prevent or limit some natural resource management practices such as the installation of fish barriers; use of motorized equipment to track, trap, or translocate animals; use of motorized equipment to treat nonnative plants; or spread of beneficial native seeds after wildfires or other large disturbance events.

Alternatives B and D would have Management Area 1.1a – Recommended Wilderness in addition to currently designated wilderness. Alternatives A and C would only have the currently designated wilderness. Most of the area proposed for Management Area 1.1a is already currently designated as roadless. Alternative D has the largest combination of wilderness and recommended wilderness, which would be protective of plant and animal species due to reduced timber harvest and the lack of motorized trails and developed recreation.

Wild, scenic, and recreational river designations are generally protective in nature, requiring the free-flowing nature of the water to be maintained and generally encouraging natural conditions in the river corridor. This can be beneficial for the plants and animals in those areas. Wild, scenic, and recreational river eligibility designations are similar across alternatives, and maintaining this eligibility would be broadly positive for the fish and wildlife species within the wild, scenic, and recreational river corridors. The impact would be minor to moderate, positive, and very similar for all four alternatives.

Research natural area and special interest area designations are generally protective of the plants and animals contained within. Existing special areas in alternative A benefit wildlife and plants. All action alternatives propose boundary modifications to existing special areas and removal of the Ripley's Milkvetch Special Interest Area, due to the positive monitoring trends since 1996. Alternative D proposes additional special interest areas and one additional research natural area and would see a broadly positive impact to the plants and animals within that area. Revised management direction in all action alternatives specific to habitat connectivity and ecosystem integrity would apply Forestwide, regardless of additional special designations.

Effects on Wildlife and Plant Species from Mineral Resource Activities

Impacts to wildlife and plant species from mineral resource activities include impacts from abandoned mines, gravel pits, hard rock mining throughout the Forest, and recreational dredging in riparian areas. Recreational dredging is further discussed in the *Aquatic Ecosystems* and *Water Resources* sections.

Under alternative A, there would be no change to the policies surrounding mineral extraction nor management direction regarding recreational dredging. All action alternatives include language more specific to dredging.

Alternative D would have the least access to and development of mineral resources due to the greatest amount of use restrictions from wilderness and special interest area designations, including the congressionally designated trail corridor. Alternative B would have reduced access and development of mineral resources, but at a smaller scale than alternative D. Alternative C would increase the access to minerals.

Cumulative Effects

The largest and most obvious past impact to fish, wildlife, and plant species on the Forest is the recent spruce-beetle impact. The resulting reduced amount of overstory canopy cover has allowed greater sunlight penetration into the understory, resulting in additional plant growth that has filled in the understory. As the effects of the beetle kill continue to progress, the formerly spruce-dominated overstory is being replaced by an herbaceous and aspen-dominated understory. Past management activities have impacted fish, wildlife, and plant species habitat. Construction of roads and trails has fragmented habitat, thereby limiting movement of some species. Increased human population and development has caused rangewide population decline for many species. Nonnative invasive plant and animal species have spread, reducing habitat for native species and causing direct mortality of chytrid fungus. Fire exclusion in areas has resulted in an increase in fuel build-up that could increase fire intensity, leading to wildfires that are more likely to escape initial attack. Overhunting and extermination efforts have also led to the extirpation of many species.

Anticipated increases in temperature and changes to timing, intensity, and amount of precipitation could impact species through the development of warmer, drier conditions.

Species of Conservation Concern

Existing Conditions and Trends

Species of conservation concern are defined in the 2012 Planning Rule as plant, animal, and aquatic species, other than federally recognized threatened, endangered, proposed, or candidate species, that are known to occur in the plan area and for which the regional forester has determined that the best available scientific information indicated substantial concern about the species' capability to persist over the long-term in the plan area (36 CFR 219.9(c)). The rule requires establishment of plan components that provide the ecological conditions necessary to maintain a viable population of each species of conservation of concern in the plan area. See Appendix C for more information about species of conservation concern.

The Rio Grande National Forest initial list of species of conservation concern was developed in Assessment 5, which is incorporated by reference (USDA Forest Service 2016). The process was initiated by assessing the Regional Forester's Sensitive Species list previously identified for the Forest. The criteria for including species in this list is described earlier in this chapter, as is the list of species included. The assessment proposed 82 plant and animal species as potential species of conservation concern (USDA Forest Service 2016). As the Forest Service developed and refined guidance for the implementation of the 2012 Planning Rule, the species of conservation concern list for the Forest was revised. The list presented earlier in this document is that revised list. Species that were considered but not carried forward on the current list are contained in Appendix C.

In terms of the affected environment for species of conservation concern, the key is the *Grouping of Species and Select Set of Ecological Conditions* that are described beginning on page 68 of Assessment 5. Although this select set of conditions is tied to monitoring, it can also serve as a useful mechanism for framing the affected environment for these species and for describing the impact of the proposed action and plan alternatives to those species. Every species on the species of conservation concern list uses or requires at least one of the conditions or features included in the select set.

Rather than describe all environmental conditions needed by all at-risk species, we are instead describing those conditions shared by one or more of the SCC and/or TEPC species, while ensuring that at least one condition required by each species is described. Assessment 5 collated the select set and described them in two groups. One group was those ecological conditions and features that could be used by one or more SCC/TEPC and that were also described in Assessments 1 and 3 (Table 58). The second group was those ecological conditions and features that were used or required by one or more species of conservation concern but that were not described or assessed in Assessments 1 and 3 (Table 59). A coarse filter of shared ecological conditions for the recovery, conservation, and viability of the listed species is represented in Table 58.

Table 58. Ecological conditions for recovery and conservation of species of conservation concern described in Assessments 1 and 3

Feature or Condition	Description	Species that use or require this feature or condition.
Large trees and snags, late-seral forests	Large enough for cavities and stable enough to support large birds	Boreal owl Flammulated owl Northern goshawk American marten Fringed myotis bat Western bumblebee
Willow thickets and cottonwood galleries	Riparian vegetation dominated by mature cottonwood trees and dense willow.	Rio Grande sucker Southwestern willow flycatcher Yellow-billed cuckoo Canada lynx Western bumblebee Colorado woodrush Silkyleaf cinquefoil
Sagebrush		Gunnison sage-grouse Brewer’s sparrow
Large aspen trees	Large enough to contain cavities and/or to support the weight of large birds.	Boreal owl Flammulated owl Northern goshawk
Alpine ecosystem, including cushion plan communities, alpine fell-fields, and talus slopes		House’s stitchwort King’s campion Gray’s draba Rocky Mountain draba Rothrock’s Townsend daisy Colorado tansy aster Colorado larkspur Stonecrop gilia Smith’s draba Shortflower Indian paintbrush
Snags		Flammulated owl American marten Boreal owl

Table 59. Ecological conditions and features that are NOT described in Assessments 1 and 3, and that are needed or used by at-risk species

Feature or Condition	Description	Species that use or require this feature or condition
Volcanic substrates: Ash-tuffs, latitic lava flows, rhyolite, andesitic substrates	These are specific soil types that many plant species are dependent upon.	Black Canyon gilia Stonecrop gilia Ripley’s milkvetch Rocky Mountain draba Colorado tansy aster Arizona willow Kings campion Rothrock’s Townsend daisy Plummer’s cliff fern Weber’s catseye Arizona willow
Sedimentary calcareous substrates	These are specific soil types that many plant species are dependent upon. Mostly shale or limestone.	Slender cliffbreak Colorado tansy aster King’s campion
Fens	Wetlands fed by mineral rich groundwater. On the Forest, many are in alpine areas. This includes iron fens.	Little grapefern Mud sedge Colorado woodrush Spiny-spore quillwort (unconfirmed) Colorado woodrush
Presence of nonnative fish and amphibians	Risk factor: Compete with, predate, or outbreed native species	Boreal toad Rio Grande cutthroat trout Rio Grande chub Rio Grande sucker
Large patches of snow willow		White-tailed ptarmigan Uncompahgre fritillary butterfly Rocky Mountain draba Colorado woodrush
Vegetation that overhangs water	Trees and shrubs that overhang the banks ponds, lakes, or slow moving pools in rivers and creeks	Rio Grande cutthroat trout Rio Grande sucker River otter
Prey: Small mammal population (prairie dogs, shrews, voles, squirrels, hares, rabbits)		Mexican spotted owl Boreal owl Flammulated owl Black footed-ferret Canada lynx American marten
Prey: Insects		Boreal toad Southwestern willow flycatcher Fringed myotis bat Townsend’s big-eared bat
Large caves and mines (stable interior temperature)	Needed for maternity colonies and hibernacula	Fringed myotis bat Townsend’s big-eared bat
Coarse substrate (aquatic)		Rio Grande chub Rio Grande sucker

Feature or Condition	Description	Species that use or require this feature or condition
Occasional disturbance	Natural, such as root wads from trees falling down, or artificial, such as trail maintenance.	Rothrock's Townsend daisy Silkyleaf cinquefoil Ripley's milkvetch
Northern flicker cavities		Western bumblebee Fringed myotis Boreal owl Flammulated owl
Floating vegetation mats		Mud sedge

The current condition of these conditions and features is described in the assessments and in the *Forested Ecosystems* section, and summarized below.

Large Trees and Snags, Late-Successional Forests

About 22 percent of spruce fir and 17 percent of the forest overall is in late-successional stages. This is projected to increase under current plan direction to 27 percent in the next 20 to 50 years. Even so, this is less than the 35-percent amount thought to be in late-successional habitat under historic conditions.

Willow Thickets and Cottonwood Galleries

Model simulations indicate that, historically, 63 percent of the ecosystem had open to mid canopy cover, with the remaining 37 percent in closed cover conditions. However, we have lower confidence in the projections for this ecosystem and the underlying models used.

Current conditions contain 30 percent of the riparian vegetation in open to mid canopy cover, substantially less than under the natural range of variation. Future projections indicate a gradual decline of mid cover areas over time. This trend away from the natural range of variation is due to the much longer fire return interval under contemporary conditions.

Management data indicate that less than 20 acres per year is treated in this ecosystem.

This system can be somewhat responsive to management. Removal of invasive plants and replanting with native species can have a mixed benefit, allowing native species an environment with reduced competition, but potentially making the habitat less complex or "messy," which is a critical feature for southwestern willow flycatcher.

Actions to restore natural flooding conditions or to raise the water table can, if maintained, be more effective at restoring native riparian vegetation than invasive plant control. However, actions of that magnitude may be beyond the scope of Forest Service management actions, as it would require significant water rights and changes in management of reservoirs, and would have downstream impacts.

Sagebrush

If the fire return interval estimates are correct, then the sagebrush shrublands are not likely to be very departed from their historic fire intervals. A reduction in fire occurrence in this type may allow conifer encroachment into shrublands.

A qualitative assessment of model results shows that much of the sagebrush shrubland ecosystem historically consisted of mid- and late-successional classes, with roughly 20 percent containing some juniper cover.

The portion of this ecosystem within the Forest boundary is mostly in late-successional classes and is slightly departed from natural range of variability.

Under historic conditions, wildfire was the dominant driver of vegetation dynamics, whereas under projected future conditions, livestock grazing is the dominant driver in this system, affecting almost 7 percent of the ecosystem on average each year. Nonnative invasive species impact an estimated 0.6 percent of the ecosystem annually, and tends to increase the frequency of wildfire where it occurs.

No management treatments were modeled in this ecosystem, as it occurs mostly outside of the Forest.

Large Aspen Trees

The assessment (USDA Forest Service 2016) states that there is less aspen than under historic conditions. However, high levels of disturbance are allowing regeneration of aspen and an increasing trend in aspen forests over the next 50 years.

Alpine Ecosystem, Including Cushion Plant Communities, Alpine Fell-Fields, and Talus Slopes

As with other non-woody ecosystems, reference conditions for alpine systems are not well-known.

Current conditions show a high proportion of late-seral conditions, similar to those under the natural range of variation.

Snags

As a result of the recent spruce beetle epidemic, the Forest has a large amount of snags and down woody material, particularly in the spruce-fir forest type. From stand exam data and forest inventory and analysis data collected, the average number of large snags that are 12 inches in diameter and larger has increased over time, especially due to the spruce beetle outbreak. There has been a dramatic increase in the number of large snags on the Forest, from about 5 per acre to about 15 to 25 per acre.

Minimum requirements for retained snags in the 1996 Rio Grande Forest Plan are the minimum requirements for adequate wildlife habitat and ecosystem function.

In general, data suggest that the Forest is well above the minimum amount of snags recommended for the various forest types. The only exception is in the ponderosa pine forest type, where both the stand exam and forest inventory and analysis data suggest that there are fewer than the desired three 14-inch snags per acre.

Many of the features and conditions listed here are not suitable for any sort of predictive or trend analysis. Some features, such as the presence of nonnative fish and amphibian species, are too responsive to human management to be usefully modeled. Others, such as volcanic soils, are not subject to trends in the same sense that biological or climate factors are. These areas can be managed and protected, but predictive modeling of them would lead to little benefit given that changes to mineral resources occur very slowly relative to human lifespans.

Many rare plant species depend upon specific soil types or substrates to survive. On the Forest, this includes the volcanic soils and calcareous substrates included in Table 59. Plant species that are dependent on those soil types, or "edaphically adapted species," are capable of growing on more common soil types but rarely do because they are out-competed by more common species. These edaphically adapted species, however, are physiologically adapted to grow in soil types that are toxic or otherwise hostile to most common species of plants, which give the edaphic species a competitive advantage in those specific soil types. As such, the well-being of these species is tied to the preservation of those areas where the specific soil types occur—typically small, isolated patches.

Fens, and the impacts to them, are described in the *Riparian, Wetlands, and Fens* section. Issues that would impact fens would also be expected to impact fen-dependent species.

Nonnative fish and amphibians include common, widely released sport fish such as rainbow and brown trout, which can outcompete and hybridize with native fish species, and can also function as predators, consuming eggs, tadpoles, fry (immature fish), and amphibian species. In warmer environments, bullfrogs can also be problematic, also acting as vociferous predators of other wetland species, while possibly also spreading chytrid fungus, which has contributed to the worldwide decline of amphibians.

Snow willow is the key habitat characteristic required by Uncompahgre fritillary butterfly. In addition, snow willow or other alpine willows may also be used by white-tailed ptarmigan as cover and foraging habitat. Snow willow is discussed in more detail in the *Uncompahgre Fritillary Butterfly* section.

Vegetation overhanging water serves multiple purposes. Shade provided by such vegetation helps control water temperature, which is critical for many species. Overhanging vegetation also provides cover for many species, including river otter. Many fish species will use such vegetation as cover and benefit from the water temperature regulation as well.

Prey species are generally analyzed not as prey but on their own merits, with the exception of those prey species that have very strong relationships with individual predator species. Some predators are fairly generalist and can hunt and consume a variety of species. Coyotes, for example, can take down a very wide variety of animals, such as sheep, stray pets, cottontail rabbits, frogs, and insects, although the bulk of their prey is native rodents. Other predators depend very strongly upon a much narrower range of prey species. Some of the most pronounced predator/prey relationships include black-footed ferret/prairie dog, Canada lynx/snowshoe hare, and black swift/flying ant. Prey species may themselves be listed as species of conservation concern or other special-status species, sometimes due solely to their role as prey, but sometimes also due to their own rarity or other characteristics that are independent of being prey.

Insect prey species tend to have different dynamics than other prey species, and commonly are functionally important as pollinators or for other ecological functions. Some insect species are prey for different predators at different phases of their life cycles. For example, mosquito larva are prey for trout species, mosquito adults are prey for bats, swifts, and swallows. Insect prey species may be regarded as pests and be subject to control efforts, including mosquito abatement.

Caves and mines are vitally important for bat species, and some bird species may also use the entrances. Most important are cave or mines that have enough interior space to maintain a stable, year-round temperature. Caves and mines are further addressed in the *Rare Communities and Special Habitats* section.

Coarse aquatic substrate is used by Rio Grande chub and sucker for spawning. Those species are examined more in-depth in the *Aquatic Ecosystems* section.

Occasional disturbance is required by many plant species to grow, but can be difficult to quantify and even more difficult to manage. Disturbances of this sort include trees falling in the forest, which can create small forest openings (if in an otherwise closed canopy) and bare soil on the root wad and in the hole created by the root wad being pulled out of the ground as the tree tipped over. The small forest openings, root wads, and root wad depressions can all be used by certain specifically adapted species. Other natural sources of occasional disturbance include burrowing rodents (such as prairie dogs and pocket gophers) that create bare soil, and bears digging up stumps or logs to access grubs. Talus slopes have their own dynamic intermittent disturbance to which some plant species have adapted to. Wildland fire is, of course, a well-studied and fascinating sort of disturbance to which entire ecosystems have adapted. In desert areas, some plant species are adapted to flash flood channels, requiring the flood activity to scarify seed coatings and water to initiate germination.

Human activities can often unintentionally mimic these natural disturbances, for either the benefit or harm of these disturbance-adapted species. Road blading and trails maintenance can mimic the soil churning aspect of burrowing rodents or flash floods and create bare soil. Off-road (especially illegal fully off-trail) motor vehicle use can churn up soil. Rare plants may take advantage of those disturbances and germinate, but may not survive long enough to set seed. This may be because the artificial disturbance occurred without the accompaniment of many of the conditions that would typically accompany a natural disturbance—for example, an action that unintentionally mimics the effects of rodent digging may occur at a time of year when such rodents would normally be hibernating below ground. Alternatively, the human disturbance may be repeated too frequently for the species to complete its life cycle.

Northern flickers create holes in snags for nesting. Other species commonly re-use the northern flicker-created cavities for nesting or hives, or as short-term roosting habitat. In some environments, efforts have been made to artificially create such flicker-created cavities (Bull et al. 1997), although that has not occurred on the Forest. The frequency of northern flicker-created cavities is probably closely tied to the number of snags, which is addressed earlier in this section as well as in the *Forested Ecosystems* section.

Floating mats of vegetation occur in wetlands, and there no information regarding the frequency or condition of such mats on the Forest. It is likely that this habitat feature is tied closely enough to wetland ecosystems for impacts to be similar. Anything that impacts wetlands could also be assumed to impact any floating vegetation mats that may occur in those wetlands.

Direct and Indirect Effects

All action alternatives include revised management direction specific to the habitat conditions necessary for the viability of the species of conservation concern listed above. Habitat impacts may occur from other uses like grazing and dispersed recreation, which are most pronounced in alpine and riparian areas. Incidental impacts from wildland fire operations also are possible. Timber, grazing, recreation, and road and trail impacts would be addressed through plan direction and site-specific analysis. Impacts from planned fire activities are primarily limited through plan direction that would be implemented during the planning phase for these operations.

Effects on Species of Conservation Concern from Vegetation Management

Primary impacts from the timber harvesting program would be to those species that use large trees and snags, or which require dense canopy cover provided by forests composed of larger trees. That would include the cavity-nesting species and large raptors. The Canada lynx-oriented plan direction, as well as timber management direction itself, both focus on the conservation and retention of snags and larger trees and patches of dense understory that remain intact from the recent beetle mortality. The majority of species of conservation concern are absent or make only limited use of suitable timber harvesting areas, including small patches of species of conservation concern habitat that are sparsely vegetated but are surrounded by denser, thicker vegetation.

Planned timber management levels are highest in alternative C and lowest in alternative D, with alternatives A and B in the middle.

Effects on Species of Conservation Concern from Prescribed Fire, Fire Use, or Fuels Management

There is some risk that fire management could have negative effects to species of conservation concern, but the net effect will likely be beneficial as conditions move toward the desired conditions and the natural range of variation.

Potential incidental impacts would be from fireline construction, staging areas, or similar actions that impact soils. These would likely be avoided in relevant habitat for species of conservation concern through the use of geospatial information systems and resource advisors during the planning process.

Planned prescribed fire levels are very similar across all alternatives, with slightly higher levels of prescribed burning in the ponderosa pine and mixed-conifer vegetation types in the action alternatives, and with the level of pile-burning in the spruce-fir vegetation type trending with the salvage harvest rate in that type. The higher levels of prescribed burning in the ponderosa pine and mixed-conifer vegetation types in the action alternatives will help move these vegetation types towards the natural range of variation and will therefore likely be beneficial for species of conservation concern.

As described in the *Fire Management* section, one major difference between the no-action and the action alternatives is the requirement to suppress all unplanned wildland fires in some of the management areas under alternative A. The action alternatives provide fire managers with more flexibility in deciding how to manage individual fires and would allow fire to play a more natural role across the landscape. In that sense, the action alternatives would allow the role of fire to be higher and more similar to its historic role, which would likely be beneficial for species of conservation concern.

Effects on Species of Conservation Concern from Livestock Management

Livestock grazing has the potential to impact plant species of conservation concern through herbivory, soil disturbance, and impacts to riparian areas. Some patches of unique soils that support plant species of conservation concern could be fenced off or otherwise protected in order to achieve protection. Additional plan direction in alternatives B, C, and D would be protective of species of conservation concern that use wetland or riparian conditions, including fens. Grazing would have minimal effect on cavity-nesting species.

Effects on Species of Conservation Concern from Roads

Roads and the use of them would have variable impact to most species of conservation concern. There is the possibility that roads in some areas could contribute toward erosion, with impacts to riparian areas; however, this can be controlled through revised plan direction which allows designs that minimize resource damage. If proper best management practices are adhered to when roads are constructed, reconstructed, or maintained, minimal amounts of erosion occurs, which diminishes over the long term.

Roads directly alter riparian vegetation when, by necessity, they cross the riparian corridors associated with streams. Roads are not permitted within wetland ecosystems, but do have the potential to alter surface and subsurface flow patterns in the vicinity of these areas.

Additional harm to species of conservation concern could result from visitor use facilitated by the road network and maintenance of that network. However, this can be limited by the use of seasonal closures. In many cases, roads built for logging operations are then used by recreationists, although these roads typically are closed and/or decommissioned after completion of the timber harvest activity.

None of the alternatives propose changes to the current road system. In alternative C, however, temporary roads are possible to accommodate increased timber harvest and recreation opportunities. In alternative D, recommended wilderness acreage would reduce motorized access.

Effects on Species of Conservation Concern from Motorized Off-Highway Travel

Off-highway vehicle travel on existing routes, big game retrieval, and dispersed recreation have the potential to impact species of conservation concern, but could facilitate illegal off-trail activity that could be harmful to plant species of conservation concern. Management direction allows for mitigation and closures if this were to become a problem.

In terms of desired summer and winter recreation opportunity spectrum classes, the acreage allocated to semiprimitive motorized activities is similar in alternatives A, B, and D and highest under alternative C.

Effects on Species of Conservation Concern from Nonmotorized Trail Management

Effects to species of conservation concern from trails would be similar to impacts from roads: the potential for erosion and the impacts of visitor access. Much like with roads, there are plan components that allow for seasonal closures if needed to protect species of conservation concern.

None of the alternatives propose changing the existing trail system. However in alternative D, some of the special interest areas, if accepted, may change the allowable trail usage, possibly reducing the number of trails. Similarly, the nonmotorized recreation opportunity spectrum classes (primitive and semiprimitive nonmotorized) are the highest under alternative D and lowest under alternative C, with alternatives A and B in the middle.

Effects on Species of Conservation Concern from Developed and Dispersed Recreation

Recreation would have minor impacts on snags, late-successional forests, and large aspen trees. Recreation can have a strong impact, however, on alpine areas, which means there is potential for impact to species of conservation concern that are found in alpine areas. Riparian areas also tend to have impacts from recreation through trampling and incidental harassment of wildlife. In the event these become an issue in alpine or riparian habitat for species of conservation concern, management direction allows for mitigation measures.

Snag and downed wood levels are affected, however, by recreation management as a result of removal of snags in campgrounds and along roadsides for safety reasons. This leads to fewer snags in these areas, and hence less future downed wood. This is also true for high-use recreation areas. The effect of this is small and similar across alternatives.

Impacts to wetlands, fens, and riparian areas include those from uncontrolled motorized use on unauthorized roads and trails. Among the action alternatives, alternative D represents a minimization of acreages that would be available for expansion of the road/trail network and would likely have the fewest impacts on riparian and wetland ecosystems. Alternatively, C represents a maximum number of acres available for the potential expansion of the motorized trail network.

Recreational activities are a stressor in some alpine areas. No alternative proposed a change in the miles of trail or number of developed facilities. Dispersed camping in the alpine zone is thought to be limited because of the higher elevation and potential difficulty of access. Much of the alpine zone is not accessible from roads or trails, is located in wilderness areas, or may not physically be accessible due to precipitous terrain. These areas may have lower impacts from recreation; however, trends discussed in the *Contributions to Social and Economic Sustainability* section suggest an increased interest in these areas.

Alternatives A, B, and C have similar acreages as suitable for over-snow vehicle use. Alternative D has less alpine area suitable for over-snow vehicle use, mostly due to the higher amount of recommended wilderness in this alternative.

Forest visitors can participate in motorized or nonmotorized activities throughout the Forest, which makes it difficult to assess recreation impacts. A more thorough analysis will be done as part of the travel management process.

Effects on Species of Conservation Concern from Designation of Wilderness, Wild, Scenic, and Recreational Rivers, Research Natural Areas, and Special Interest Areas

These designations would be generally protective of species of conservation concern, especially plant species of conservation concern. Existing and recommended wilderness designations may limit the methods used by the Forest to meet invasive species and fuels management objectives, thereby limiting the ability to address those two issues, which can be deleterious to some species of conservation concern. The overall impact would be positive, and highest in alternative D, which has the most recommended wilderness, wild, scenic, and recreational river, research natural area, and special interest area designations.

For more detail on existing and proposed special areas and their nexus with the key ecosystem characteristics necessary for the viability of species of conservation concern, see the *Rare Communities and Special Habitats* and *Proposed Special Interest Areas and Research Natural Areas* sections.

Effects on Species of Conservation Concern from Mineral Resource Activities

The impacts to species of conservation concern from extraction of mineral resources includes abandoned mines, gravel pits, hard rock mining throughout the Forest, and recreational dredging in riparian areas. Recreational dredging is further discussed in the *Aquatic Ecosystem* and *Water Resources* sections.

Under alternative A, there would be no change to the policies surrounding mineral extraction nor management direction regarding recreational dredging. All action alternatives include language more specific to dredging.

Alternative D would have the least access to and development of mineral resources due to the greatest amount of use restrictions from wilderness and special interest area designations, including the congressionally designated trail corridors. Alternative B would have reduced access and development of mineral resources, but at a smaller scale than D. Alternative C would increase the access to minerals.

Cumulative Effects

Baseline conditions for each ecosystem considered for species of conservation concern are provided in the *Affected Environment* section.

Large Trees and Snags, Late-Successional Forests

The cumulative effects identified in the *Forest Products* section are not expected to increase or decrease over current trends. The cumulative effects to species of conservation concern that use large trees and snags and late-successional forests are expected to be similar due to plan components that have been designed to address the concern for the ability of the species to persist.

Willow Thickets and Cottonwood Galleries

Human activities in the planning area include grazing, removal of trees, and construction of dams and diversions that regulate water flow, block aquatic organisms, and alter erosional processes. Declining groundwater levels and the elimination of flooding have altered plant composition and structure, notably causing the decline of cottonwoods and willow systems. At the programmatic scale, the cumulative effects on species of conservation concern are not expected to increase beyond current trends.

Sagebrush

Under future projections, exotic annual grass species and juniper expansion displace much of the native sagebrush. Projections also show an increase in early seral shrubs, such as rabbitbrush (*Chrysothamnus* and *Ericameria* species). Programmatic effects at the forest plan level would likely have a beneficial cumulative effect due to plan components that favor sagebrush ecosystem enhancements, resulting in an increase of quality habitat for species of conservation concern that use the habitat.

Large Aspen Trees

Over the long term, from many decades to hundreds of years, models project the recovery of most forested ecosystems toward the natural range. Because of the mortality occurring in the spruce-fir ecosystem, aspen is expected to increase in higher elevations. However, at mid- to lower elevations, aspen may decrease due to fire suppression as well as other changes in structural composition.

Alpine Ecosystem, Including Cushion Plant Communities, Alpine Fell-Fields, and Talus Slopes

Given the heavy sheep grazing that occurred in many of these alpine communities (particularly pre-Taylor Grazing Act), it is likely that plant composition is altered, water runoff patterns have been altered, and the amount of erosion has increased. Mining, roads, and development associated with mining are other anthropogenic activities that have likely influenced these systems through reduced vegetation cover, provided pathways for nonnative species, altered water run-off patterns, and increased erosion (Somers and Floyd-Hanna 1996, Paulson and Baker 2006). Additionally, mine tailings from mining activities have caused water pollution problems and increased soil toxicity. Finally, in more recent years, the more popular alpine systems have been impacted by increased recreation uses.

While mining is expected to decrease in this ecosystem type, recreation is expected to increase. The indirect effects of the recreation program are not expected to result in an increase in cumulative effects due to forest plan components designed to minimize effects to this ecosystem and the species that rely on it.

Snags

As snags fall and down woody material decays, the habitat quality for species that use snags, such as cavity-nesting species and some raptor species, decreases. Down woody debris contributes to increased soil building through decomposition. How fast this happens will depend on the forest type and a variety of other factors. Still, given the slow nature of these processes, a large amount of snags and down woody material will persist on the Forest, especially in the spruce-fir forest ecosystems, into the foreseeable future. Long term, it is difficult to predict how snag and down woody amounts may change. Plan components require specific snag retention criteria at the project level for the purpose of supporting habitat for species of conservation concern. Only negligible cumulative effects are expected to occur to snag habitat used by species of conservation concern.

Infrastructure, Roads, and Facilities

Overview

The developed infrastructure on the Forest includes roads, trails, utility corridors, dams, and buildings for administrative, recreational, or special use purposes. A map showing *Existing National Forest System Roads* is contained on the DVD located at the back of this document.

Affected Environment, Existing Conditions, and Trends

The road and trail systems in the planning area provide access to public lands and private inholdings. Both motorized and nonmotorized access are important for providing outdoor recreation, managing wildfire, managing livestock and wildlife, developing natural resources (including timber and minerals), gathering fuel wood, accessing private in-holdings, maintaining electronic sites and utility corridors, and managing and monitoring the planning area.

Modes of vehicle travel in the planning area include large commercial trucks, automobiles, pickups, four-wheel drive vehicles, snowmobiles, all-terrain vehicles, and off-highway vehicles, motorcycles, mountain bikes, and wheelchairs. Other travel modes include cross-country skiing, horseback riding, and hiking. Linear travelways include roads such as paved highways, gravel and dirt roads, unimproved or primitive roads, four-wheel drive roads, and trails designated for motorized and/or nonmotorized use. Off-road motorized travel is allowed only off designated routes and is limited to 300 feet alongside roads for dispersed recreation and firewood gathering. All-terrain vehicles may travel off the designated roadway to retrieve game during specified time periods.

Infrastructure in the plan area can have a substantial impact on social, cultural, economic, and ecological conditions both in the plan area and in the broader landscape. Infrastructure can include facilities for energy generation or transport, communications, water delivery, transportation (including airstrips), or recreation. These facilities directly affect conditions and uses within the plan area and may support delivery of goods and services in the broader landscape.

Roads

A total of approximately 2,242 miles of National Forest System roads (public and administrative), in addition to state and county roads, lie within the proclaimed Forest boundary, along with approximately 1,288 miles of National Forest System trails. This mileage reflects the mileage in the travel analysis process report. Administrative roads are for Forest Service personnel, contractors, and permittees and, therefore, likely have much less use and are not maintained as well as public system roads. Annual motor vehicle use maps produced by the Forest show which roads are open to public motorized travel; all other roads are used for administrative purposes or are unauthorized and under consideration for decommissioning. Private roads are roads that provide access to private property. Private roads are administered as easements or special use permits and are considered in the lands special use analysis. Differences among alternatives are based on limitations and desired conditions in the alternatives that would guide future site-specific decisions about roads and access.

National Forest System roads are operated and maintained according to road maintenance levels (Table 60) and provide for designated public motorized use or intermittent use for administrative purposes (gated). Level 1 roads may be gated but are available for administrative trips. Roads at maintenance levels 2 through 5 may be open for year-round use, weather or wildlife permitting. Some roads may be temporarily gated to secure an area for administrative purposes, public safety or health, or to protect resources.

- Level 1 roads are closed to motorized use by the general public and are available for administrative use. These roads may be opened to the public intermittently. Basic custodial maintenance is performed to protect resources and the road investment.
- Level 2 roads are open to public use and are passable by high-clearance vehicles. The road surface is generally native material. These are typically single lane roads and can have steep grades. Traffic volume and speed is normally low.
- Level 3 is assigned to roads open and maintained for travel by passenger vehicles. These roads are not maintained for user comfort. These are typically low-speed, single-lane roads with turn-outs. They may be either native or gravel surfaced.
- Level 4 roads provide a moderate degree of user comfort at moderate travel speeds. These roads are typically double lane and are gravel surfaced.
- Level 5 is assigned to roads that provide a high degree of user comfort. These roads are typically double-lane, paved roads.

Table 60. Miles of National Forest System roads by maintenance level

Maintenance Level	Miles	Percentage
1	645	29
2	978	43
3	598	27
4	20	0.9
5	1	<0.1
Total	**2,242**	**100**

Trails

National Forest System trails are designated based on allowable usage. Trails in wilderness do not allow mechanized or motorized usage. Trails outside of wilderness may be designated as pedestrian, horse, mechanized (e.g., mountain bike), or motorized, or a combination of these (Table 61).

A portion of the 3,100 mile Continental Divide National Scenic Trail meanders between the San Juan and Rio Grande National Forests, necessitating shared management responsibility for many miles of this significant trail. For more information on trails, see the *Congressionally Designated Trails* and *Sustainable Recreation Opportunities* sections.

Table 61. Miles of National Forest System trails

Type of Trail	Miles	Miles
Motorized	399	
Nonmotorized	889	
Total	**1,288**	
Wilderness		454
Non-wilderness		834
Total		**1,288**

Building and Other Facilities

Forest Service buildings and structures (both administrative and recreation) support administrative and recreation programs Forestwide. Current administrative sites are a function of past history. A number of them were built in the early 1900s, with some dating back to 1908. Over the past, as administrative units were combined, the Forest has obtained a mixture of new Forest Service owned/leased buildings and numerous other buildings that do not meet current health and safety standards.

The infrastructure of the Forest is aging. Facilities condition surveys identify a life cycle of 50 years for building replacement. At this time, 28 percent of the administrative buildings meet or exceed the recommended lifecycle, with an additional 9 percent expected to reach the lifecycle recommendation within the next 10 years. Water and wastewater systems range from more than 40 years old, to more recent updates less than 8 years old. Forest-owned dams and communication systems are also aging and requiring major maintenance or replacement. A summary of the number and types of constructed features can be found in Assessment 11 (USDA Forest Service 2016).

A facility master plan was completed in 2017 to guide the acquisition, continued use, maintenance, improvements, and disposal of Forest Service administrative facilities on the Forest. With declining budgets and an aging infrastructure with significant deferred maintenance levels, the Forest is in a reactionary versus planned position in regards to maintenance needs. Health and safety for the public and employees is the priority, and every effort is made to ensure that issues are resolved in a timely manner.

Direct and Indirect Effects

None of the alternatives propose changing the current road system. Guidance for the transportation system in the forest plan is limited to the management of roads and trails within Forest Service jurisdiction. Forest management activities significantly affecting the transportation system are road and trail construction, reconstruction, maintenance, and decommissioning.

Under the 2005 Travel Management Rule (36 CFR 212. 5), national forests are required to “identify the minimum road system needed for safe and efficient travel and for administration, utilization, and protection of National Forest System lands” as well as to identify unneeded roads that could be “decommissioned or considered for other uses, such as for trails.” The Forest’s 2015 travel analysis process report developed proposed actions for identification of the future minimum road system and "likely unneeded" roads. The proposed actions will be analyzed in future travel management projects.

In alternative D, additional wilderness analyzed and additional special interest areas, if accepted, would change the allowable trail usage and reduce the number of motorized trails.

None of the alternatives propose changing the current status of facilities. Evaluations for decommissioning existing facilities and new facility construction are not addressed at the forest-plan level. Health, safety, and sustainable operations, however, are factors to consider in managing facilities.

Cumulative Effects

Because there are no proposed changes to the roads and road maintenance program, there are no direct or indirect effects. Although Forest infrastructure could undergo some renovation and improvements, there is not expected to be an increase beyond what already exists. There would likely be increased demand for roads, trails, and facilities, and that may result in an increase in cumulative effects from those specific programs; however, that would be subject to the fiscal capabilities of the Forest and therefore is not expected to be significant.

Scenery

Overview

National Forest System lands adjacent and visible to communities provide a sense of place, contribute to the identity of the communities, and provide an integral component of forest settings. The jagged peaks of the Sangre de Cristo Mountains are an integral part of the community of Crestone's unique setting. Similarly, Bristol Head and Wason Park are integral parts of the scenery above Creede. It is important to manage scenic resources to ensure quality sightseeing and other recreation opportunities, as well as maintain natural landscapes for communities adjacent to the Forest. Scenic resource values are important elements of the Forest's distinctive roles and contributions.

Scenic character is defined as the 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.

Affected Environment, Existing Conditions, and Trends

The Forest provides a scenic backdrop and sense of place for many communities in the San Luis Valley. This region is heavily influenced by early Spanish settlers who brought their culture and practices with them. The historic buildings, communities, and agricultural and irrigation practices contribute positively to the identity of the San Luis Valley.

The landscape consists of mosaics of forested stands and open meadows or parks. Lower elevations are dominated by pinyon-juniper stands, and riparian corridors are fringed with cottonwood and other riparian vegetation. Middle-elevation forest lands are composed of aspen stands intermingled with mixed conifer, with spruce-fir stands dominating the landscape. Topography varies from rugged peaks to rolling hills, in addition to some mesas with high deserts.

The Forest is home to the headwaters of the Rio Grande, and many forest visitors seek out the view of the 100-foot drop of North Clear Creek Falls. Other popular waterfalls on the Forest include Piedra Falls, Saguache Falls, Silver Falls, and South Clear Creek Falls. Eligible rivers included in the National Wild and Scenic Rivers System include scenery as an outstandingly remarkable value.

Naturally evolving landscapes are showcased in the Sangre De Cristo, La Garita, Weminuche, and South San Juan Wildernesses. Additionally, numerous inventoried roadless areas that provide natural appearing landscapes are located throughout the Forest. Forest landscapes change throughout the year, with the seasons providing excellent winter scenery as well as a spectacular display of wildflowers in the summer, and sight-seeing opportunities during the fall leaf-peeping season.

Views from the Silver Thread Scenic Byway include the resurgent dome near Creede, the Pyramid in the Weminuche Wilderness, the Rio Grande corridor, and Bristol Head overlook. Visitors to the byway can also take in unique geologic features, historic sites, and wildlife. The Los Caminos Antiguos Scenic Byway is also known as the “Ancient Road.” Views from this byway include the scenic Conejos River, Conejos Canyon Overlook, Rio de Los Pinos, portions of the South San Juan Wilderness, and the Cumbres & Toltec Scenic Railroad.

For more details on the scenic resources on the Forest, refer to Assessment 8.1, which is hereby incorporated by reference (USDA Forest Service 2016).

Scenic Condition

The Forest Service visual management system was used to evaluate the visual condition of the Forest in 1993, prior to the release of the Landscape Aesthetics Handbook, which documents replacement of the visual management system with the scenery management system (USDA Forest Service 1995). The handbook provides inventory direction for existing scenic integrity of forest landscapes using the scenery management system. Although alternative A represents the existing scenic integrity, some terminology used in alternative A is inconsistent with the current scenery management system terminology, such as the categorization of scenic condition. A crosswalk between the terms used in the visual management system and scenery management system is contained in Table 62.

Table 62. Crosswalk of terms used in the visual management and scenery management systems

Visual Management System (visual condition)	Scenic Management System (scenic condition)
Natural Appearing	Very High
Slightly Altered	High
Altered Appearing	Moderate
Heavily Altered	Low or Very Low

The results of the visual condition evaluation conducted during the previous planning effort, using the visual management system, are listed in Table 63. Visual condition translates to scenic condition as used in the scenery management system (Table 62). The previous visual condition evaluation represents a detailed look at the Forest at that time. It is important to note that several events have occurred across the Forest that have likely impacted scenic resources since the previous evaluation was completed. These events include, but are not limited to, timber harvest due to insects, blowdown, and increased tree mortality. In some areas, an entire viewshed is currently of dead trees. These viewsheds, likely categorized as “natural appearing” in the previous evaluation, could now be characterized as “altered appearing” (or, moderate) given their current state.

Table 63. Scenic condition of the Forest

[Source: Rio Grande National Forest Assessment 8.1 Multiple Uses – Scenic Character]

Visual Condition[1] (scenic condition)	Acres	Percent of Forest
Natural Appearing (Very High)	1,506,638	81
Slightly Altered (High)	288,383	16
Altered Appearing (Moderate)	34,674	2
Heavily Altered (Low or Very Low)	26,842	1

[1] Using visual management system terminology.

Natural Appearing: A viewshed where no more than 5 percent of the area is visually modified.

Slightly Altered: A viewshed where no more than 10 percent of the area is visually modified.

Moderately Altered: A viewshed where no more than 20 percent of the area is visually modified.

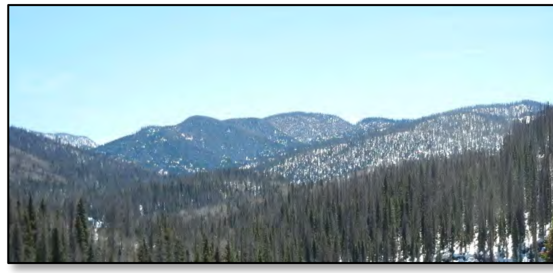
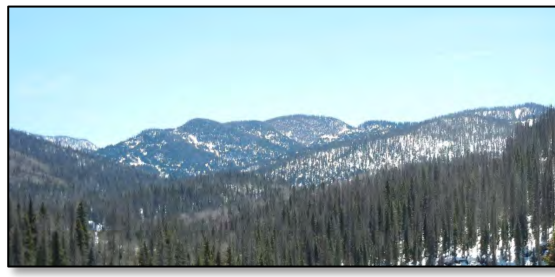
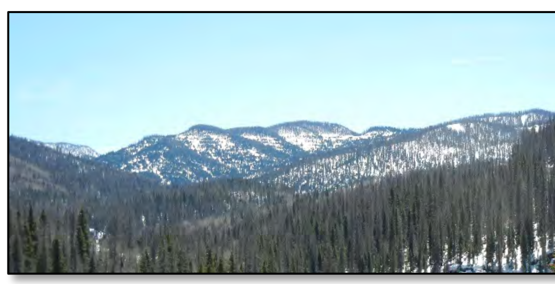
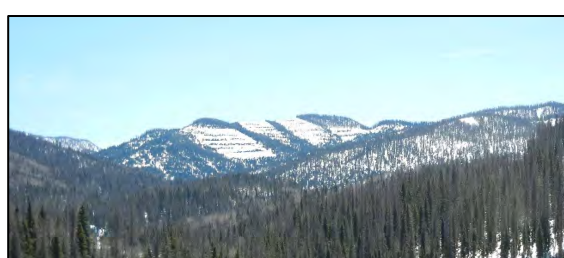
Heavily Altered: A viewshed where no more than 20 percent of the area is visually modified.

As shown in Table 63, the majority of landscapes are managed to appear natural (81 percent). This is done through a variety of management approaches including providing semiprimitive, nonmotorized recreation settings, roadless areas, and designated wilderness areas.

Scenic Integrity

Scenic integrity measures the degree to which a landscape is free from visible disturbances that detract from the natural or socially valued appearance of a viewshed, including visible disturbances due to human activities or extreme natural events outside of the natural range of variation. Scenic integrity measures these disturbance effects in degrees of consistency, harmony, dominance, and contrast with the valued scenic character. Scenic integrity uses a graduated scale of five levels: very high, high, moderate, low, and very low (Table 64). The visual examples were simulated from a landscape that is characteristic of the current scenic condition of the Forest, with a large number of dead and dying trees due to the spruce beetle. The missing canopy and grey trees have exposed more of the ground over much of the forest canopy across the Forest. The simulations were created from the same viewpoint to show different harvesting levels and techniques in the middleground and background, and how they represent each of the different scenic objectives described below. The increasing amount of straight line edges, contrast on the visible landscape, and visible ground indicates increasing levels of management activity and lowered objectives.

Table 64. Scenic integrity levels

Scenic Integrity Level	Example
Very High Integrity – the valued scenery appears natural or unaltered. Only minute visual disturbances to the valued scenery, if any, are present.	
High Integrity – the valued scenery appears natural or unaltered, yet visual disturbances are present; however, they remain unnoticed because they repeat the form, line, color, texture, pattern and scale of the valued scenery.	
Moderate Integrity – the valued scenery appears slightly altered. Noticeable disturbances are minor and visually subordinate to the valued scenery because they repeat its form, line, color, texture, pattern and scale.	
Low Integrity – the valued scenery appears moderately altered. Visual disturbances are co-dominant with the valued scenery, and may create a focal point of moderate contrast. Disturbances may reflect, introduce or "borrow" valued scenery attributes from outside the landscape being viewed.	
Very Low Integrity – the valued scenery appears heavily altered. Disturbances dominate the valued scenery being viewed; and they may only slightly borrow from, or reflect, valued scenery attributes within or beyond the viewed landscape. Very Low is never an objective.	

The existing scenic integrity of the Forest is shown in Table 65. The scenic integrity map was updated to correct unintended errors from data migration and updates and to incorporate land exchanges. Only four of the five levels are shown because "very low" scenic integrity does not occur on the Forest.

Table 65. Existing scenic integrity (alternative A)

Forest lands	Scenic Integrity Level			
	Very High	High	Moderate	Low
Acres	428,527	1,159,754	363,872	7,968
Percent	22	59	19	Less than 1

Concern Levels

Landscapes are viewed to varying degrees from different locations and therefore differ in importance to the public. To assist scenic inventory and analysis, this importance can be ranked by concern levels. Concern levels indicate the degree of relative importance of aesthetics the public attributes to a given landscape. Sites, travelways, special places, and other areas are assigned a concern level value of 1, 2, or 3 to reflect the relative high, medium, or low importance of aesthetics. The decision matrix for determining concern levels is shown in Table 66. This guide can be tailored to local conditions.

Table 66. Hierarchy of concern level

Area type (use level)	Public interest in scenery		
	High	Moderate	Low
Primary travelway/use area (high use)	1	2	2
Primary travelway/use area (moderate use)	1	2	2
Primary travelway/use area (low use)	1	2	3
Secondary travelway/use area (high use)	1	2	2
Secondary travelway/use area (moderate use)	1	2	3
Secondary travelway/use area (low use)	1	2	3

Source: USDA Forest Service (1995).

Scenic Classes

Scenic classes represent the relative landscape value by combining visibility mapping inventories and scenic attractiveness inventories. Generally, scenic classes 1 and 2 have high public value, classes 3, 4, and 5 have moderate value, and classes 6 and 7 have low value. Scenic classes also identify the relative priority for public scenery concerns during the forest plan alternative development process. Measured scenic classes then form the baseline for developing scenic integrity objectives.

Scenic Integrity Objectives

Scenic integrity objectives are developed in coordination with the recreational setting, management direction, and scenic class that were developed from the scenic inventory. Allocation of scenic integrity objectives varies by alternative and supports an integrated management approach to accomplishing Forest stewardship goals. Scenic integrity objectives represent desired conditions to be managed toward. The identified scenic integrity objectives may be higher in some locations than inventoried scenic integrity levels. Management in these conditions should support achievement of the identified scenic integrity objectives or advancement toward their achievement. Maps showing *Existing Scenic Integrity for Alternative A* and *Desired Scenic Integrity Objectives for Alternatives B, C, and D* are contained on the DVD located at the back of this document.

Direct and Indirect Effects

Scenery is affected by management activities that may alter the appearance of the landscape. Short-term effects to scenery are generally considered in terms of degree of deviation from desired conditions. The scenic character can be changed over the long term or cumulatively by alteration of the landscape. Management activities that have the greatest potential of affecting scenery include the following:

- Vegetation management and road construction/reconstruction
- Special use utility rights-of-ways
- Mineral extraction
- Fire activity.

A difference of 23,866 acres in total acreage is shown on the scenic integrity objective maps between alternative A and alternatives B, C, and D. This difference is due to various land sales, acquisitions, and exchanges that have taken place since 1996.

Scenic Integrity Objective and Recreation Opportunity Spectrum Nexus

Enjoyment of scenery is typically a key aspect of recreational experiences in a given setting. Similarly, recreational activities also influence scenic backdrops and corridors. For these reasons, recreation and scenic resource values are generally managed hand-in-hand. Scenic integrity objectives and recreation opportunity spectrum class designations establish preferred scenic and recreational conditions that should be considered in project-level analysis. Forest activities are managed to be consistent with both scenic integrity objectives and recreation opportunity spectrum class designations. If activities are not consistent with scenic integrity objectives and/or recreation opportunity spectrum class designations, progress towards consistency should actively occur. Recreation opportunity spectrum class designations are considered when developing scenic integrity objectives. Some combinations of recreation opportunity spectrum classes and scenic integrity objectives are more compatible than others. The crosswalk of compatibility determinations between the two management tools is shown in Table 67.

Table 67. Recreation opportunity spectrum and scenic integrity objective compatibility

[Source: USDA Forest Service (1995). The “urban” recreation opportunity spectrum class and “very low” scenic integrity objective were removed from the table for the purposes of this analysis discussion because there are no “urban” recreation opportunity spectrum class designations nor “very low” scenic integrity objectives on the Forest.]

Recreation Opportunity Spectrum Class	Scenic Integrity Objectives			
	Very High	High	Moderate	Low
Primitive	Norm	Inconsistent	Unacceptable	Unacceptable
Semiprimitive Nonmotorized	Fully Compatible	Norm	Inconsistent	Unacceptable
Semiprimitive Motorized	Fully Compatible	Fully Compatible	Norm	Inconsistent
Roaded Natural	Fully Compatible	Norm	Norm[1]	Norm
Rural	Fully Compatible	Fully Compatible	Norm	Norm

[1]Norm from sensitive roads and trails.

The scenic integrity objectives for each action alternative are generally compatible with recreation opportunity spectrum class designations (Table 67). However, some deviations occur due to certain areas being out of the visible range for visitors due to topography, vegetation, or access limitations. For example, semiprimitive nonmotorized recreation opportunity spectrum class is “inconsistent” with moderate scenic integrity; however, this overlap in inconsistent designations occurs in several small areas across the Forest in alternative B simply because those areas are not actually visible.

Alternative A (No Action)

The scenic integrity objectives for alternative A (Table 65) would remain the way they are currently mapped. Some terminology in management direction is inconsistent with current scenery management system terminology, such as the categorization of scenic condition. Project-level and other activities would meet or move toward those previously identified scenic integrity objectives. Management activities would continue to be consistent with established scenic integrity objectives. Viewers could expect to see natural changes on the landscape from tree mortality, possible fires, as well as blow down.

Common to All Action Alternatives (B, C, and D)

Alternatives B, C, and D contain plan components to address long-term management and stewardship of the valued scenic character of the Forest.

Alternative B

Under alternative B, project-level and other activities would meet or move toward the defined desired scenic integrity objectives (Table 68). The scenic integrity objectives for alternative B are nearly the same as those for alternative A, with a slight increase in high integrity and a slight decrease in very high scenic integrity objective. These slight percentage differences are attributed to the 23,866-acre difference in the total acreage within the scenic integrity objective maps between alternatives A and B due to various land exchanges since 1996.

Table 68. Alternative B scenic integrity objectives

Scenic Integrity Objective	Very High	High	Moderate	Low
Percent	20	61	19	<1

To develop the scenic integrity objectives for alternative B, the existing scenic integrity objectives (alternative A) were first compared to the desired summer recreation opportunity spectrum for alternative B. Changes were made in the scenic integrity objective map to avoid instances of “unacceptable” compatibility with recreation opportunity spectrum classes (Table 67). For example, any semiprimitive nonmotorized areas overlapping low scenic integrity objectives were converted to moderate scenic integrity objectives to move toward achieving higher scenic integrity with minor noticeable disturbances in landscapes managed for nonmotorized recreation. However, areas where scenic integrity objectives were “inconsistent” with recreation opportunity class designations remained for alternative B. For example, any semiprimitive motorized areas with a low scenic integrity objective remained low under alternative B. Low scenic integrity means that scenery appears moderately altered.

Other considerations were made when developing scenic integrity objectives for alternative B beyond compatibility to recreation opportunity class designations. All existing wilderness areas retained their existing very high or high scenic integrity objective. All additional lands analyzed for recommended wilderness under alternative B were assigned a high scenic integrity objective. All eligible wild, scenic, and recreational river one-half-mile corridors were assigned a high or very high scenic integrity objective. Additionally, the Continental Divide National Scenic Trail was assigned a high or very high (in areas through existing primitive wilderness) scenic integrity objective within the one-mile trail corridor. A narrower, one-half-mile corridor was used where the trail corridor abuts Wolf Creek Ski Area. Wolf Creek Ski Area was assigned a moderate scenic integrity objective within the ski area boundary. The Baca Mountain Tract in the Sangres portion of the Saguache District was assigned a high scenic integrity objective under alternative B.

Under alternative B, visitors could expect to see scenic changes on the landscape from natural processes. Timber harvest and other management activities would be managed to be consistent with scenic integrity objectives. In areas of low scenic integrity objectives, management activities may be evident with road construction and various harvesting activities. Facility development is possible under alternative B across the Forest within motorized recreation opportunity spectrum classes. Management activities within the one-half- to one-mile corridor for the Continental Divide National Scenic Trail would prioritize trail values.

Alternative C

The scenic integrity objectives under alternative C are shown in Table 69. Project-level and other activities would meet or move toward the desired scenic integrity objectives for alternative C. Alternative C scenic integrity objectives are nearly the same as the desired objectives for alternatives A and B.

Table 69. Alternative C scenic integrity objectives

Scenic Integrity Objective	Very High	High	Moderate	Low
Percent	20	61	19	<1

To develop the scenic integrity objectives for alternative C, the existing scenic integrity objectives (alternative A) were compared to the desired summer recreation opportunity spectrum for alternative C. Changes were made in the scenic integrity objective map to avoid instances of “unacceptable” compatibility with recreation opportunity spectrum classes (Table 67). For example, any semiprimitive nonmotorized areas overlapping low scenic integrity objectives were converted to moderate scenic integrity objective to aspire to achieve higher scenic integrity with minor noticeable disturbances in landscapes managed for nonmotorized recreational use. However, areas where scenic integrity objectives were “inconsistent” with recreation opportunity class designations remained for alternative C to allow for more development and timber harvest opportunities provided for under alternative C, compared to all other alternatives. For example, any primitive areas with a high scenic integrity objective remained high under alternative C. High scenic integrity means that scenery appears natural or unaltered despite some visual disturbances. Visual disturbances, such as historic structures, could exist in a wild, remote setting that is predominantly unmodified by man and managed for nonmotorized and nonmechanized recreation.

Other considerations were made when developing scenic integrity objectives for alternative C beyond compatibility to recreation opportunity class designations. All existing wilderness areas retained their existing very high or high scenic integrity objective. No additional Forest lands are being analyzed for recommended wilderness designation under alternative C. Additionally, the Continental Divide National Scenic Trail was given a high or very high (in areas through existing primitive wilderness) scenic integrity objective within the trail’s one-mile corridor. A narrower, one-half-mile corridor was used where the trail corridor abuts Wolf Creek Ski Area. Wolf Creek Ski Area was given a moderate scenic integrity objective within the ski area boundary.

Under alternative C, visitors could expect to see more landscape changes as compared to alternatives B and D due to reduced very high and high scenic integrity objectives, increased moderate and low scenic integrity objectives, as well as increased potential for development and timber harvest. Management activities within the one-half- to one-mile corridor for the Continental Divide National Scenic Trail would also be prioritized trail values under alternative C. However, additional management activities may be visible in background views to trail users from the Continental Divide National Scenic Trail under alternative C due to the increased potential for development and timber harvest. Management activities may also be visible in background views to visitors along concern level 1 roads and trails, along the two scenic byways, and from some campgrounds and recreation areas.

Alternative D

The scenic integrity objectives under alternative D are shown in Table 70. Project-level and other activities would meet or move toward the desired scenic integrity objectives for alternative D. Under alternative D, there is a 16-percent increase in very high scenic integrity and mild decreases in high (9 percent) and moderate (7 percent) scenic integrity objectives. Notably, alternative D would not have any low scenic integrity objectives.

Table 70. Alternative D scenic integrity objectives

Scenic Integrity Objective	Very High	High	Moderate	Low
Percent	36	52	12	0

To develop the scenic integrity objectives for alternative D, the existing scenic integrity objectives (alternative A) were compared to the desired summer recreation opportunity spectrum for alternative D. Changes were made in the scenic integrity objective map to avoid instances of both “unacceptable” and “inconsistent” compatibility with recreation opportunity spectrum classes (Table 67). For example, any semiprimitive nonmotorized areas overlapping moderate scenic integrity objectives were converted to high scenic integrity objective. Additionally, all low scenic integrity objectives were changed to moderate. These changes were made to pursue higher scenic integrity in landscapes managed for both motorized and nonmotorized recreation.

Other considerations were made when developing scenic integrity objectives for alternative D beyond compatibility to recreation opportunity class designations. All existing wilderness areas retained their existing very high or high scenic integrity objective, with primitive wilderness portions being very high. All additional lands analyzed for recommended wilderness designation under alternative D were given a very high scenic integrity objective. All eligible scenic rivers were given a very high scenic integrity objective within their half-mile corridors, and all eligible wild or recreational rivers were given a high scenic integrity objective within their one-half-mile corridors. Additionally, the Continental Divide National Scenic Trail was given a high or very high scenic integrity objective within the one-mile trail corridor. A narrower, one-half-mile corridor was used where the trail corridor abuts Wolf Creek Ski Area. Wolf Creek Ski Area was given a moderate scenic integrity objective within the ski area boundary. The Baca tract in the Sangres portion of the Saguache District was given a very high scenic integrity objective under alternative D.

Alternative D would provide the highest degree of scenic resource protection. Many areas would convert from a high scenic integrity objective to very high to due increased lands being analyzed for recommended wilderness designation, as well as additional special designation areas under alternative D. Forest visitors would still see evidence of tree mortality on the landscape due to insect and disease outbreaks. However, management of many of these areas would allow natural processes to take place, limiting the amount of human-caused alterations on the landscape. Landscapes would appear more intact and more influenced by natural processes under alternative D as compared to all other alternatives. Management activities within the one-half- to one-mile corridor for the Continental Divide National Scenic Trail would prioritize and promote trail values, and trail users would see less human-caused alternation to the landscape under alternative D. Views from scenic byways, and concern level 1 and 2 roads and trails, would experience less landscape alterations under alternative D. Visitors would see fewer deviations on the landscape under alternative D as compared to alternative B, and notably fewer deviations on the landscape as compared to alternative C.

Effects to Scenic Resources from Vegetation Management and Roads

Commercial timber harvest activities may result in road construction and reconstruction. Timber harvesting has a variety of short-term effects that may be evident to visitors based on the type of logging system used, type of silvicultural treatment, and the slope of and visibility from roads and trails. Road construction may introduce unnatural visual elements into the landscape resulting in form, line, color, and texture contrasts, such as cut slopes and switchbacks viewable from other roads, exposed rock and soils, stumps, and slash piles.

The scenic character would remain more intact under alternatives B and D as compared to alternative C because of the reduced amount of activities. However, there would still be evidence of tree mortality, which may change the characteristic landscape from forested to nonforested. Many of these areas may retain more texture on the landscape due to the presence of standing dead timber left in stands.

Effects to Scenic Resources from Fire Management

Blackened vegetation and soil, charred tree trunks, and reddish-brown needles on dead trees would be the main visual effects from fire; these effects would decrease over time. In areas where mechanical equipment is used in fire suppression, visual contrast from fireline construction could be evident depending on the slope, amount of vegetation removed by the fire, amount of mineral soil exposed, and success of post-suppression restoration efforts. Some effects from fire in fire-adapted ecosystems may be beneficial to scenery. These effects include increased overall visual diversity by promoting mosaics of vegetative types that reflect natural conditions.

Alternative D would likely have the least impact to scenic resources from fire and fuel management because this alternative would achieve desired conditions for wildlife and other resources though greater use of natural ecosystem processes, such as management of planned and unplanned fire ignitions.

Effects to Scenic Resources from Mineral Resource Activities

Mining activities can involve major landform alteration, as well as form, line, color, and texture contrasts, resulting in adverse scenic impacts. Most lands outside of designated wilderness would be suitable for mineral extraction, in all alternatives. In alternative D, however, with additional wilderness acreage analyzed, minerals management would be reduced and scenic resources would be least impacted.

Cumulative Effects

The analysis area and temporal scope for cumulative effects are the Forest over the life of the forest plan. Areas modified by timber harvest would continue to appear highly managed, and scenic integrity would be affected. The degree to which these landscapes would be affected would be evaluated on a project-level basis following forest plan direction to achieve the desired scenic integrity objective for the area. Timber harvest and other development on adjacent private, state, and other federal lands may influence overall scenic integrity in southern Colorado, including on the Forest. However, the Forest's characteristic landscape, or scenic backdrop, above the valleys will remain generally unchanged regardless of which alternative is selected. Driving for pleasure and other scenery-dependent activities could be affected slightly by human disturbance to areas beyond the Forest boundary. Cumulative effects to scenic resources are expected to continue to be consistent with the current trend, although they are not considered significant at the programmatic scale.

Sustainable Recreation Opportunities, Access, Use, and Settings

Overview

Sustainable Recreation

The 2012 Planning Rule defines sustainable recreation as "the set of recreation settings and opportunities on the National Forest System that is ecologically, economically, and socially sustainable for present and future generations." To address this requirement, focus areas were developed under the Framework for Sustainable Recreation (USDA Forest Service 2010) and the Rocky Mountain Region's Leadership Intent for Outdoor Recreation (USDA Forest Service 2015a). National focus areas include the restoration and adaptation of recreation settings; implementation of "green" operations; investment in special places; enhancement of communities; development of strategic partnerships; promotion of citizen stewardship; improvement of knowledge about forest visitors, community stakeholders, and other recreation providers; ensuring that the right information is provided to the public; and ensuring development of a sustainable financial foundation as well as the Forest Service's own workforce. Regional focus areas include strengthening the Forest Service identity, investing in the workforce's professional skills, fostering adaptation of facilities and programs, augmenting the financial foundation, and promoting citizen stewardship.

The 2012 Planning Rule also requires that a forest plan include plan components "to provide for sustainable recreation; including recreation settings, opportunities, and access; and scenic character. Recreation opportunities may include nonmotorized, motorized, developed, and dispersed recreation on land, water, and in the air" (36 CFR 219.10(b)(1)(i)). With the national focus areas and regional goals in mind, the Forest developed a strategy for implementing sustainable recreation at the Forest level. The Forest's sustainable recreation vision means facilitating access to enduring recreational opportunities across a variety of settings on the Forest that (1) meet both the persisting and changing needs of the public, (2) support the ecological health of the forest, (3) promote high-quality visitor experiences, (4) strengthen individuals' connection to the outdoors and sense of stewardship, and (5) are backed by innovative funding and effective partnerships.

Recreation Opportunity Spectrum

Recreation on national forests encompasses more than just the activities themselves. Outdoor recreation is generally described in terms of several integrated aspects: recreation opportunities, access, use, and settings. These individual elements, examined in further detail below, collectively represent how recreation resources are valued, considered, and managed. Further, integration of these elements ultimately produces specific recreation experiences for Forest visitors based on the chosen activity, equipment, and timeframe within a given setting. This range of opportunities, access, use and settings is called the recreation opportunity spectrum. The Forest Service uses this tool to facilitate providing opportunities for high-quality and satisfying recreation experiences to match a broad range of visitors and interests.

The recreation opportunity spectrum describes different settings available across a given landscape and the attributes associated with those settings. The level of access, development, and social encounters increases when moving from primitive (P) to urban (U) on the spectrum. The level of remoteness and solitude increases when moving from urban (U) to primitive (P) on the spectrum (USDA Forest Service 1990).

The recreation opportunity spectrum has six distinct classes in a continuum ranging from highly modified and developed settings to primitive and undeveloped settings. There are five recreation opportunity spectrum classes that apply to the Rio Grande: rural, roaded natural, semiprimitive motorized, semiprimitive nonmotorized, and primitive. There are no urban recreation opportunity spectrum class designations on the Forest. The recreation opportunity classes are briefly described as follows:

- **Rural** – This setting is characterized by a substantially modified natural environment that includes the most developed recreation sites. Facilities are designed primarily for user comfort and convenience with a considerable number of facilities designed for large group use. Interactions between users are very frequent in a rural setting.
- **Roaded natural** – This setting is managed as natural appearing with sections of development that support high concentrations of use, user comfort, and social interaction. Resource modifications are evident but generally harmonize with the natural environment. The road system is typically well defined and can generally accommodate passenger car travel. System roads also provide access to other recreation opportunity spectrum settings of semiprimitive motorized, semiprimitive nonmotorized, and primitive areas.
- **Semiprimitive motorized** – This setting is managed for backcountry motorized use on designated routes. Routes are designed for off-highway vehicles and other high-clearance vehicles. This setting offers visitors motorized opportunities for exploration, challenge, and self-reliance. Mountain bikes and other mechanized transport are also sometimes present. Rustic facilities exist for the primary purpose of protecting the area’s natural resources or providing portals to adjacent areas of primitive or semiprimitive nonmotorized areas.
- **Semiprimitive nonmotorized** – This setting includes areas of the Forest managed for nonmotorized use. Semiprimitive nonmotorized settings are not as vast or remote as primitive settings, but offer opportunities for nonmotorized exploration, risk, and self-reliance. Mountain bikes and other mechanized equipment are often present. Rustic facilities exist with the primary purpose of protecting the area’s natural resources.
- **Primitive** – This setting is remote, wild, and predominantly unmodified by man. Neither motorized nor mechanized activities are allowed and there is very low probability of user interactions. Primitive settings are managed for quiet and solitude away from roads,

people, and development. There are few, if any, facilities or developments. Most primitive settings coincide with designated wilderness and areas of recommended wilderness.

Application of the Recreation Opportunity Spectrum Tool

As an inventory step, the Forest's existing summer recreation opportunity spectrum was mapped using the recreation opportunity spectrum from the 1996 forest plan as a base. From there, the procedures outlined in the draft *National Recreation Opportunity Spectrum Mapping Protocol* (USDA Forest Service 2016a) were followed to update the class designations based on changes since the previous forest plan. These updates included incorporating land exchanges, reflecting changes adopted by forest plan amendments, and correcting for unintended errors from geographic information system data migration and updates since 1996.The three largest summer recreation opportunity spectrum classes on the Forest are semiprimitive nonmotorized (43 percent), semiprimitive motorized (28 percent), and roaded natural (20 percent) (Table 71). These three classes currently account for 91 percent of Forest lands. Refer to the *Existing Summer Recreation Opportunity Spectrum* map, which is contained on the DVD located at the back of this document.

Table 71. Existing summer recreation opportunity spectrum settings

Percent of Recreation Opportunity Spectrum Class Designations[1]				
Primitive	**Semiprimitive Nonmotorized**	**Semiprimitive Motorized**	**Roaded Natural**	**Rural**
8	43	28	20	1

[1] Recreation opportunity spectrum class designations are not applied to private lands located within the Forest boundary.

Combining the two nonmotorized classes (primitive and semiprimitive nonmotorized) and three motorized classes (semiprimitive motorized, roaded natural, and rural), an estimated 51 percent of the Forest currently provides a nonmotorized setting, and 49 percent of the Forest currently provides a motorized setting during the summer season.

For comparison purposes, the desired recreation opportunity spectrum for the summer season was mapped across the Forest for each alternative according to the methodology for mapping recreation opportunity spectrum contained in Forest Service handbook direction. Each alternative was analyzed for the total number of acres and percentage of the desired summer recreation opportunity spectrum settings.

The desired recreation opportunity spectrum for the winter season is forthcoming and should be available for use during the Forest's future travel management process.

Motorized *Over-Snow Vehicle Use Suitability* maps for alternatives A through D (contained on a DVD located in the back of this document) reflect areas on the Forest where motorized over-snow vehicle use would be suitable and unsuitable for each alternative. This process does address motorized and nonmotorized settings during the winter season to determine suitability of these activities throughout the Forest. Over-snow vehicle use suitability determinations were made based on considerations for recreation user group preferences, wilderness areas, wildlife habitat, and areas of the Forest under long-term closure orders where applicable. Each alternative was then analyzed for the total number of acres and percentage of the Forest where motorized over-snow vehicle use would be suitable, unsuitable, and limited to designated routes. Over-snow vehicle use suitability determinations are not travel management decisions; however, suitability determinations can be used to inform travel management decisions when the Forest undergoes that separate decision-making process.

Over-snow vehicles are defined as "motor vehicles designed for use over snow that run on a track or tracks and/or a ski or skis, while in use over snow" (36 CFR 212.1). Where "wheeled motor-vehicle use" is considered in this analysis relative to road, trail, and area or cross-country travel, it includes all types of motor vehicles as defined at 36 CFR 212.1, except motorized over-snow vehicles. Wheeled motor vehicles include automobiles, four-wheel drive vehicles, and off-highway vehicles, except over-snow, as well as those vehicles that have driving wheels moving inside endless tracks, or are capable of such conversion, when operating outside snow-covered ground conditions. Effects of "wheeled motor vehicle use" and "motorized over-snow vehicle use" are analyzed as separate activities in this document. When the term motorized access or motorized recreation is used, it refers to all vehicles, including both wheeled and over-snow vehicles. Mechanized or mechanical transport describes the use of bicycles, wagons, and carts.

Recreation data are generally retrieved from the Forest Service INFRA database. This is a collection of reporting and mapping tools, using geographic information system data, used to manage and report accurate information about inventory of constructed features and land units.

The national visitor use monitoring system also informs the analysis and provides the most relevant, reliable, and accurate information on Forest visitation. National visitor use monitoring data are collected on every national forest every 5 years, using a random sampling method that yields statistically valid results.

Assessment 9 – Recreation (USDA Forest Service 2016b) is incorporated by reference; it contains more information regarding recreation opportunities and use on the Forest.

Geographic information system data were used in mapping the recreation opportunity spectrum and motorized over-snow vehicle use suitability among alternatives. Discrepancies in total acreage among alternatives can generally be attributed to geographic information system mapping realignments and routine database updates.

Affected Environment, Existing Conditions, and Trends

Considered to be one of the most remote national forests in the Southern Rockies, the Rio Grande National Forest is arguably one of the most isolated national forests in the Rocky Mountain Region. The closest interstate highway, I–25, is nearly 70 miles from the closest trailhead at Lake Como and the Blanca Peak complex. The Forest's remote location and comparatively undeveloped nature means that many recreational users find themselves in solitude, or more likely to interact with wildlife or cattle than other recreational users. Increased interest, however, in hiking 14,000-foot peaks, or fourteeners, as well as deferred maintenance due to declining budgets since 1996, have impacted the ability of the Forest to sustain its recreation infrastructure.

In 2007, the Forest conducted a recreational facility analysis to characterize the quality of developed recreational opportunities on the Forest, given the qualities described above. The purpose of the analysis was to help prioritize sustainable management of the recreation program under declining budgets. The recreation facility analysis process identified niche settings on the Forest with corresponding niche emphasis activities and opportunities: remote adventure, solitude, scenic corridors, scenic backways, and winter overlay (USDA Forest Service 2007). For more information about the recreational facility analysis and niche statement, see Assessment 9 – Recreation (USDA Forest Service 2016b).

Recreation Opportunities

Motorized vehicle use is currently limited to designated routes outside wilderness or Colorado roadless areas. Motorized use is also prohibited in some eligible wild, scenic, and recreational river segments and research natural areas. Designated routes are defined on the Forest's motor vehicle use map. Motorized over-snow vehicle use is currently allowed on 64 percent and prohibited on 26 percent of the Forest. The remaining 10 percent includes areas where motorized over-snow vehicle use is limited to designated routes. Terrain and vegetation, however, limit access to the entire 64 percent. Over-snow vehicles can travel cross-country in all management areas except wilderness. Travel management was analyzed in the current forest plan.

Nonmotorized activities are unrestricted and occur in winter and summer. Mechanized transport, such as mountain bikes and fat-tire bikes that ride over snow, are not allowed in wilderness. Outside of wilderness, mechanized use is restricted to designated routes.

As stated in the recreation assessment, combining unrestricted motorized and nonmotorized use may result in increased safety concerns. Additionally, the 2013 monitoring report specifically identified potential conflict between motorized over-snow vehicles and winter range (big game).

Developed recreation activities occur at defined sites, including facilities such as campgrounds, picnic areas, interpretive sites, trailheads, parking areas, boat ramps, fishing piers, rental structures, restrooms, and drinking water sources. The main developed recreation activities on the Forest are overnight camping at developed campsites, trailhead use, fishing at developed fishing sites, and downhill skiing at Wolf Creek Ski Area, which is operated under a special use permit.

The number of developed recreation sites on the Forest is listed by category in Table 72. In addition to specific categories such as campgrounds and trailheads, the other developed recreation category includes day-use sites such as boat and fishing facilities and administrative sites such as cabin rentals. Information on site capacity in contained in Assessment 9 – Recreation (USDA Forest Service 2016b).

Table 72. Forest Service developed recreation sites

Developed Site Type	Total Sites
Boating Site	7
Campground	40
Fishing Site	10
Group Picnic Site	4
Interpretive Site	11
Lookout/Cabin	11
Observation Site	2
Picnic Site	10
Ski Area Alpine	1
Target Range	1
Trailhead	59
Total	156

Source: INFRA Recreation site report (October 31, 2014).

Developed sites are operated and maintained by the Forest, a concessionaire, or through other permitted services. Not all of the 40 campgrounds on the Forest have running water because of associated costs and other constraints. Most campgrounds and other facilities at higher elevations are open on a seasonal basis, typically Memorial Day through Labor Day.

Developed sites located at lower elevations are generally open year-round, but the actual operating season varies due to weather or temporary closures related to maintenance. If a site cannot be maintained to meet health and safety standards, the site is closed until the issue is remedied. Management emphasis for developed sites is the high-use summer months, and other peak-use times such as elk and deer hunting seasons. The Forest's developed recreation sites are typically not completely full even during the peak-use seasons.

Partnerships, volunteerism, and new management strategies have played an increasing role in maintaining and improving developed recreation facilities and trails on the Forest. The level of facilities and programs currently available is dependent on these partnerships with commercial and private operators, listed below. The Federal Lands Recreation Enhancement Act is one tool that allows the Forest Service to collect fees, which help provide services, maintenance, and improvements that benefit visitors.

During fiscal years 2015 and 2016, partners and volunteers contributed a total of 45,740 hours of work to the Forest. These hours account for efforts completed by individual and group volunteers, international visiting volunteers, partnerships, and organization agreements, including the Southwest Conservation Corps, Volunteers for Outdoor Colorado, Colorado Mountain Club, and Colorado Fourteeners Initiative, among others. These groups leverage volunteers to complete trail maintenance and invasive species remediation. The San Luis Valley Great Outdoors coalition is another potential partner. This coalition generated the 2014 San Luis Valley Trails and Recreation Plan (San Luis Valley Great Outdoor Coalition 2014), which lays the foundation for improving outdoor recreation opportunities in the San Luis Valley over the next 10 years, including opportunities in the Forest.

Dispersed recreation is another opportunity on the Forest. Fees are generally not charged for dispersed areas, which are typically concentrated along roads or near water and have few or no facilities such as toilets, tables, or garbage bins. Under current regulations, motorized vehicles and campers must be within 300 feet as measured from the centerline of designated roads (USDA Forest Service 2017). Since 1996, the popularity of dispersed recreation has increased on the Forest, reflecting Colorado and New Mexico's population growth. This has led to health and safety concerns, including littering and human waste. Additionally, resource degradation is occurring including vegetative removal, trampling, soil erosion, and wildlife disturbance. More information on popular dispersed recreation areas is contained in Assessment 9 – Recreation (USDA Forest Service 2016b).

Several natural features on the Forest provide unique recreation opportunities (see the *Natural Features* map, which is contained on the DVD located in the back of this document). Some of these features fall under a special interest area designation, while others are managed for their values within a larger management area. These areas are Wheeler Geologic Area, the Summer Coon Volcanic areas including Elephant Rocks, the Natural Arch, and Devils Hole and Blowout Pass Geologic Areas. The Forest also has six 14,000-foot peaks ("fourteeners," as mentioned previously), which attract increasing summer use. Those peaks are all in the Sangre de Cristo range and include Crestone Peak, Crestone Needle, Kit Carson Mountain, and portions of Ellingwood, Little Bear, and Blanca Peaks. Since 1996, interest has grown significantly in this form of destination hiking, which concentrates impacts at base camps and along trails accessing these peaks. The Colorado Fourteeners Initiative has partnered with the Forest on a number of projects to provide sustainable trail maintenance and stewardship education.

The Continental Divide National Scenic Trail and Old Spanish National Historic Trail are additional unique recreation opportunities that are further described under their own section in Chapter 3. About 80 miles of the Colorado Trail also pass through the Forest, roughly in step with the Continental Divide National Scenic Trail. The Colorado Trail is a long-distance trail that stretches nearly 500 miles from Denver to Durango. Major uses are hiking, mountain biking, and horseback riding. While the Colorado Trail has no official management designation on the Forest, it was built, and is currently maintained, by volunteers of the Colorado Trail Foundation and the Forest Service. The Colorado Trail Foundation is another active partner of the Forest Service.

More information on recreation opportunities on the Forest is contained in Assessment 9 – Recreation, and Assessment 15 – Designated Areas (USDA Forest Service 2016b).

Access

People seeking recreation opportunities can access the Forest through a combination of state and county roads, as well as roads and trails maintained by the Forest that are considered National Forest System roads and trails. These routes are designated on the motor vehicle use map and reflected in visitor use maps.

As described in the *Infrastructure, Roads, and Facilities* section, National Forest System roads are categorized into five road maintenance levels that define the level of service and maintenance required. Mileage by maintenance level for National Forest System roads is listed in Table 60.

According to the roads analysis report for the Forest (USDA Forest Service 2004), the overall spatial distribution and amount of access (roads, trails, parking areas, and trailheads) across the Forest is sufficient. In 2015, however, an updated travel analysis process report provided additional information on the sustainability of the Forest Service road system, based on a review of funding levels from 2008 to 2012. The report (USDA Forest Service 2015b) recommended a "minimum road system" with suggested significant reductions to the current road system. This report is considered advisory until travel management planning occurs subsequent to this effort.

The total miles of trails by primary managed use type is shown in Table 73. Several trails are managed for multiple use with the primary managed use type, however, and designed for the most demanding construction and maintenance parameters. For example, trails specifically designed, constructed, and maintained for pack-and-saddle use also accommodate hiker use. There is a total of approximately 1,399 miles of trails on the Forest, 490 miles (35 percent) of which are located in designated wilderness and 909 miles (65 percent) of which are located outside of designated wilderness.

Table 73. Trail miles by primary managed use type

Primary Managed Use Type	Miles[1]
Hiker	63
Pack and saddle	902
Motorcycle	203
Off-highway vehicle	191
Cross-country skiing	18
Snowmobile	613[2]
Total	1,990

Source: INFRA II Trail Core Report (April 10. 2017).

[1] All inventoried routes are located within the Forest boundary; however, the entire length of each individual segment may not be located on Forest Service lands.

[2] While there are no official snowmobile trails in INFRA, these trails represent those currently permitted and established.

As discussed under the *Sustainable Recreation Opportunities* section, the Forest includes portions of the Continental Divide National Scenic Trail and the Old Spanish National Historic Trail, both of which are further discussed under the *Congressionally Designated Trails* section. The Forest also contains West Lost Trail Creek trail (commonly known as West Lost Trail) on the Divide Ranger District, which is part of the National Recreation Trails system. These National Forest System trails are designated to recognize exemplary trails of local and regional significance. The West Lost Trail is located on the western edge of the Divide Ranger District and accommodates both nonmotorized and motorized use. The 7.5-mile long trail can be accessed either via National Forest System Road 520 or the Continental Divide National Scenic Trail.

Los Caminos Antiguos Scenic Byway, Silver Thread Scenic Byway, and Cumbres & Toltec National Historic Landmark, a scenic railroad, are all scenic corridors that pass through the Forest. The routes described below are shown on the *Scenic Byways and Railroads* map, which is contained on the DVD located in the back of this document.

More information about these scenic resources is contained in Assessment 9 – Recreation, and Assessment 8.1 – Scenic Resources (USDA Forest Service 2016b), and in the *Scenery* section. For more information on the roads and trails, see the *Infrastructure, Roads, and Facilities* section.

Recreation Use

National Visitor Use Monitoring

Every five years, the Forest Service monitors their visitor use through surveys. Survey standards have evolved through refinement as each round of national surveys was conducted. A site visit is defined as the entry of one person onto a national forest site or area to participate in recreational activities for an unspecified period of time. National visitor use monitoring results represent a “snapshot” of the sample year’s visitation patterns and activities at the Forest scale and do not provide any true “trend” measures or site-specific visitation data at this time. (USDA Forest Service 2015c). Although the tool is not perfect, and it is highly dependent on the location of survey points and the willingness of visitors to participate, it is the only tool currently available to gather this information.

Visitor use and satisfaction information provided by national visitor use monitoring, are good indicators of the types of recreation opportunities and settings that Forest visitors prefer. The Forest participated in the national visitor use monitoring program in 2000, 2005, 2010, and 2015. Forest visitation results for 2015 are listed by visit type in Table 74.

Table 74. Recreation visits to the Forest, 2015

[Source: Rio Grande National Forest 2015 National Visitor Use Monitoring Survey (USDA Forest Service, 2015c)]

Visit Type	Visits	90-percent Confidence Level[2]
Total Estimated National Forest Visits	396,000	±12.2
Total Estimated Site Visits	463,000	±14.0
Day Use Developed Site Visits	249,000	±16.8
General Forest Area Visits	113,000	±36.4
Overnight Developed Site Visits	62,000	±23.3
Designated Wilderness Visits[1]	39,000	±62.4

[1] Visits to designated wilderness are included in the site visits estimate.

[2] This value defines the upper and lower bounds of the visitation estimate at the 90-percent confidence level; for example, if the visitation estimate is 100 ±5 percent, one would say “at the 90-percent confidence level, visitation is from 95 to 105 visits.”

A national forest visit can be composed of multiple, more specific site visits within the larger visit. Out of the total site visits in 2015, most visitors frequented the area outside of designated wilderness. A total of 424,000 site visits (91.5 percent) were attributed to visitors spending time at developed day-use sites, overnight sites, or general forest areas.

Overall visitor satisfaction for the Forest is very high. In 2015, more than 76 percent of visitors responded with an overall rating of “very satisfied.” Another 18 percent were “somewhat satisfied.” Less than 2 percent indicated any level of dissatisfaction.

Visitors also indicated their perception of how crowded recreation sites or areas felt. Crowding levels were rated on a scale of 1 to 10, where 1 denotes hardly anyone was there and 10 indicates the area was perceived as overcrowded. Day-use developed sites received an average rating of 5.6, overnight developed sites were rated 3.9, undeveloped areas in general forest were rated 2.9, and designated wilderness received an average rating of 5.4. These low averages indicate that crowding is generally not an issue on the Forest.

Visitor Use

The Forest attracts visitors from near and far (Table 75). More than 68 percent of visitors in 2015 reported travelling from a distance of more than 100 miles, and almost 37 percent of visitors traveled more than 500 miles. In contrast, slightly more than 25 percent of visitors originated from the local area within 50 miles of the Forest. Most visitors (70 percent) reported coming to the Forest from one to five times per year. More than 15 percent of respondents said that they visit from 6 to 20 times per year, and a small subset of 5 percent of visitors reported frequenting the Forest from 51 to 100 times annually.

Table 75. Percentage of visits to the Forest by distance travelled, 2015

[Source: Rio Grande National Forest 2015 National Visitor Use Monitoring Survey (USDA Forest Service, 2015c)]

Miles from Survey Respondent's Home to Forest Interview Location[1]	Percentage of Forest Visits
0–25 miles	12.1
26–50 miles	13.5
51–75 miles	3.3
76–100 miles	2.5
101–200 miles	14.7
201–500 miles	17.3
More than 500 miles	36.6

[1] Travel distance is self-reported.

Most visitors to the Forest participate in several recreation activities during each visit in addition to their main activity. For example, a visitor may come to the Forest to camp at one of the campgrounds but they may also participate in other activities such as hiking or viewing natural features. The top five activities for Forest visitors in 2015 were, in order of preference, downhill skiing, hunting, fishing, hiking/walking, and viewing natural features. These five activities account for 78 percent of total visitation.

Participation rates by the top five activities on the Forest in 2015 are shown in Table 76. As an example, this table shows that 40 percent of visitors identified hiking and walking as a recreational activity that they participated in, but only 7 percent of those visitors identified it as their main activity during their Forest visit. In contrast, nearly 47 percent of Forest visitors identified downhill skiing as a recreational activity that they participated in, with downhill skiing representing a congruent 45 percent of visitors' main activity on the Forest.

Table 76. Top five activities on the Forest by participation rate, 2015

[Source: Rio Grande National Forest 2015 National Visitor Use Monitoring Survey (USDA Forest Service, 2015c)]

Top Five Activities	Participation (percent)[1]	Main Activity (percent)[2]
1. Downhill skiing	46.9	45.2
2. Hunting	11.6	11.3
3. Fishing	17.4	8.8
4. Hiking/walking	40.0	7.2
5. Viewing natural features	29.6	5.6

[1] This column may total more than 100 percent because survey respondents could select multiple activities.

[2] Survey respondents were asked to select only one of their activities as their main reason for the Forest visit. Because some respondents selected more than one, this column may total more than 100 percent.

Recreation Special Uses

The Forest's special uses permit program includes a recreation component, related to noncommercial and commercial events, activities, and privately owned improvements on National Forest System lands. A special use authorization is a legal document granted for a specific use of the land for a specific period of time. Special use permits can be authorized for temporary or long-term periods.

At this time, there are 32 outfitter and guide permits providing a variety of commercial services on the Forest, as well as a special use permit for Wolf Creek Ski Area. The Forest is currently experiencing increased requests for outfitter, guide, and recreation event permits. For more information on special uses, refer to the *Lands and Special Uses* section.

Recreation Settings

People choose a specific setting to engage in recreational activities in order to realize a desired set of experiences. For example, camping in a large undeveloped area with difficult access and limited facilities offers a sense of solitude, challenge, and self-reliance. In contrast, camping in an easily accessible setting that includes developed facilities, such as toilets and tables, provides more comfort, security, and opportunities for social interactions. The Forest Service strives to provide diverse opportunities for recreationists to obtain high-quality and satisfying experiences through a variety of settings and activities (USDA Forest Service 1982).

Direct and Indirect Effects

Sustainable Recreation

Generally, the recreation plan direction does not vary among alternatives B, C, and D in order to fully support the Forest's sustainable recreation vision. However, the type of access and available settings vary among action alternatives based on variations in summer recreation opportunity spectrum class designations, as well as over-snow motorized vehicle use suitability determinations described in the analysis below.

Alternative A does not specifically account for the concept of sustainable recreation because the ideas and practices associated with the concept have evolved in recent years. However, many of the principles associated with sustainable recreation were present in plan direction developed in 1996. Under this management direction, the Forest's recreation program would continue without a sustainable focus for the program over the planning period.

Alternatives B, C, and D contain revised plan direction to help achieve sustainable recreation and address recreation settings, opportunities, and access for nonmotorized, motorized, developed, and dispersed recreation opportunities. This revised direction will help the Forest keep and re-evaluate which facilities and trails will be maintained and connected, as well as focusing all management decisions on resource benefits.

Recreation Opportunity Spectrum

Alternative A reflects the Forest's existing summer recreation opportunity spectrum mapped in 1996 and is based on the factors considered at that time. The class designation percentages are listed in Table 77.

Table 77. Existing summer recreation opportunity spectrum settings

Percent Recreation Opportunity Spectrum Class Designations[1]				
Primitive	Semiprimitive Nonmotorized	Semiprimitive Motorized	Roaded Natural	Rural
8	43	28	20	1

[1] Recreation opportunity spectrum class designations are not applied to private lands located inside the Forest boundary.

All action alternatives reflect implementation of the methodology described in this section's overview. Following that exercise, a map was created with the percentages listed in Table 78, which summarizes the recreation opportunity spectrum class designations for alternatives B, C, and D. The action alternatives contain plan direction to help achieve sustainable recreation and address recreation settings, opportunities, and access for nonmotorized, motorized, developed, and dispersed recreation opportunities. This revised direction would help the Forest keep and re-evaluate which facilities and trails would be maintained and connected, and would focus all management decision on resource benefits.

The allocation of desired summer recreation opportunity spectrum classes for each alternative is shown in Table 78. Refer to the *Existing Summer Recreation Opportunity Spectrum* map and the *Desired Recreation Opportunity Spectrum* maps for alternatives B, C, and D for geographic depictions of recreation opportunity spectrum class designations for each alternative. These maps are all contained on the DVD that is located at the back of this document.

Table 78. Desired summer recreation opportunity spectrum classes, by action alternative

Alternative	Percent Recreation Opportunity Spectrum Class Designations[1]				
	Primitive	Semiprimitive Nonmotorized	Semiprimitive Motorized	Roaded Natural	Rural
B	7	44	28	20	1
C	7	33	36	23	1
D	36	19	25	19	less than 1

[1] Recreation opportunity spectrum class designations are not applied to private lands located inside the Forest boundary.

In alternatives B, C, and D, Forest plan direction requires that recreation development and travel routes are to be consistent with the Forest's desired recreation opportunity spectrum class designations described above. Plan direction also provides for managing capacity within recreation opportunity spectrum class designations, including the number of special use permits concentrated in a particular area or the capacity of a site to provide long-term versus short-term use.

The desired recreation opportunity spectrum class designations vary, by alternative, in part, on the basis of changes in management area allocation. Management areas that influenced the allocation of recreation opportunity spectrum class designations by alternative are recommended wilderness; special interest areas including scenic byways and railroads; research natural areas, and special designations: congressionally designated trails. Fine-scale variations in recreation opportunity spectrum class designations among alternatives are also attributed to local knowledge of recreation user preferences and demands within each of the Forest's three ranger districts. These nuances influence acreage changes in class designations among alternatives but typically do not affect class designation percentages because the changes are so site-specific and small in size.

Across all alternatives, rural and roaded natural recreation opportunity spectrum class designations remain nearly the same, with a slight (3 to 4 percent) increase of roaded natural in alternative C due to temporary road development for increased timber harvest opportunities under alternative C. Semiprimitive motorized allocation is nearly the same between alternatives B and D, with the highest semiprimitive motorized allocation in alternative C. Under alternative C, areas with closed roads are classified as a semiprimitive motorized class designation within a 0.5-mile buffer on each side of the road. Similar changes are reflected in alternative C in response to scoping comments requesting several nonmotorized trails be opened to motorized use. These changes were made to potentially provide for more motorized opportunities on the Forest under alternative C. Opening closed routes and determining route uses are, however, outside the scope of this plan revision.

Semiprimitive nonmotorized is the highest in alternative B and lowest in alternative D, with a 25-percent difference between alternatives B and D and a 14-percent difference between alternatives C and D. Alternative D has the lowest allocated semiprimitive nonmotorized opportunities because much of those lands designated as semiprimitive nonmotorized in alternatives B and C are allocated as primitive in alternative D. This shift among alternatives is primarily due to all existing designated wilderness, and all recommended wilderness, being given a primitive class designation under alternative D. Accordingly, the primitive recreation opportunity spectrum class is 29 percent higher under alternative D than both alternatives B and C.

The total nonmotorized and motorized opportunities by combined recreation opportunity spectrum class percentages across all action alternatives are shown in Table 79. The nonmotorized recreation opportunity spectrum classes (primitive and semiprimitive nonmotorized) are the highest under alternative D. This is largely because of the estimated 285,000 acres of recommended wilderness under alternative D, as opposed to approximately 59,000 acres of recommended wilderness under alternative B and none in alternative C. A higher percentage of nonmotorized settings under alternative D would offer more opportunity for quiet solitude experiences and reduce the probabilities of seeing or hearing other people in remote and predominantly unmodified landscapes.

Table 79. Nonmotorized and motorized settings, by alternative

Alternative	Total Nonmotorized (percent)	Total Motorized (percent)
A	51	49
B	51	49
C	40	60
D	55	45

Motorized opportunity settings including semiprimitive motorized, roaded natural, and rural, are greater under alternatives B and C compared to alternative D. This is largely due to the amount of recommended wilderness under alternative D, as detailed above. Alternative C provides for the most motorized settings because alternative C does not have recommended wilderness. Additionally, under alternative C, semiprimitive nonmotorized contiguous areas equal to or less than 2,500-acres in size were converted to semiprimitive motorized. Likewise, semiprimitive motorized contiguous areas equal to or less than 2,500 acres in size were converted to roaded natural in alternative C. These combined changes reflect 11 to 15 percent more total motorized settings under alternative C as compared to alternatives B and D. A higher percentage of motorized settings under alternative C would provide more opportunity for recreation experiences in more developed landscapes with higher chances for social interactions and access to developed facilities.

Motorized Over-Snow Vehicle Use Suitability

The percentage of Forest lands suitable, unsuitable, and limited to designated routes for motorized over-snow vehicle use is listed by alternative in Table 80. For geographic depictions of motorized over-snow vehicle suitability for each alternative, refer to the *Over-Snow Vehicle Use Suitability* maps for alternatives A, B, C, and D, each of which is contained on the DVD located at the back of this document.

Table 80. Motorized over-snow vehicle use by alternative

Alternative	Over-Snow Vehicle Use[1]		
	Percent Suitable	Percent Unsuitable	Percent Limited to Designated Route
A[2]	64	25	11
B	59	26	15
C	61	24	15
D	37	50	13

[1] Over-snow suitability designations do not include private lands located inside the Forest boundary.

[2] Areas where snowmobiles are allowed on the Forest's current winter use map are reflected as suitable and unsuitable for over-snow vehicle use under alternative A for the purposes of comparison.

Motorized over-snow vehicle use would be suitable on the highest percentage of Forest lands under alternative C, with a slight (2 percent) increase from lands deemed suitable for motorized over-snow vehicle use under alternative B (Table 80). Inversely, motorized over-snow vehicle use would be unsuitable on 25 percent more of Forest lands under alternative D as compared to alternatives B and C. The percentage differences between suitable and unsuitable across action alternatives are described in more detail below. Areas where motorized over-snow vehicles are limited to designated routes is nearly the same across all three action alternatives due to limited variations in deer and elk winter range that determine the need for designated routes in certain areas during the winter season.

Suitable

Areas suitable for motorized over-snow vehicle use across all action alternatives (B, C, and D) include Roadless (MA 3.5 and 3.6), General Forest (MA 5.11), and Scenic Byways (MA 4.21). Motorized over-snow vehicle use is also suitable under alternatives B and C in the following special interest areas: Bachelor Loop, Elephant Rocks, and Wagon Wheel Gap Experiment Station. Suitable areas under alternatives B and D also include dispersed and developed recreation, forest production, and grassland production.

Unsuitable

Areas unsuitable for motorized over-snow vehicle use across action alternatives (B, C, and D) include existing wilderness areas, eligible wild, scenic, and recreational rivers, ski-based resorts, all research natural areas, and the following special interest areas: Blowout Pass Geologic, Devil's Hole, and Liberty-Duncan. Motorized over-snow vehicle use across all alternatives is also unsuitable within areas on the Forest with closure orders. Specifically, the long-term closure order for a 543-acre area in the vicinity of Chama Basin is specifically in place to prevent winter recreation use conflicts.

Under alternative B, 58,669 acres of recommended wilderness would also be unsuitable for motorized over-snow vehicle use. Under alternative D, all special interest areas would be unsuitable for motorized over-snow vehicle use. Additional unsuitable areas under alternative

D are: backcountry, congressionally designated trails, and 284,853 acres of recommended wilderness. Alternative C does not have any recommended wilderness.

Limited to Designated Routes

Motorized over-snow vehicle use is limited to designated routes located within deer and elk winter range (MA 5.41) under alternatives B, C, and D. Alternatives B and C also limit motorized over-snow vehicle use to designated routes within the John C. Fremont Winter Camp Special Interest Area.

Management Areas

Several differences in management area allocations by alternative would result in minor changes to how recreation would be managed on the Forest. In alternatives A, B and D, developed and dispersed recreation fall under Management Area 4.3 – Dispersed and Developed Recreation. Alternative C, however, combines those areas under the broader general forest management area. Recreation opportunities and related developed facilities would not change, however, and area-specific plan direction is combined into the larger designation.

Management for ski-based resorts remains the same in all alternatives, although the management area number in alternative C differs from that in A, B and D. Under alternative C, Wolf Creek Ski Area would be managed as a special designation. The special designation in C further solidifies the terms of the special use permit into management direction in the forest plan itself.

Effects to Sustainable Recreation Opportunities from Vegetation Management

Associated impacts of timber management might include road reconstruction and improvements. New road construction is likely to be limited and temporary road construction used as a more common method for short-term administrative access needs.

Road development for timber management purposes in undeveloped areas may have the potential to attract more visitors to the interior of the Forest where access previously has been limited. However, the vast majority of planned harvest activities would occur in previously developed areas where management has occurred in the past and roads are already in place. Temporary roads may be used to access newly accessible parts of the Forest, but these areas would be immediately adjacent to areas of the Forest already under active management. All currently closed roads would remain closed and all new temporary roads would be decommissioned.

Planned vegetation management activities are lowest in alternative D; therefore, alternative D would generally be expected to result in a lower amount of administrative and vegetation management-related road use compared to alternatives A, B, and C. Consequently, reduced traffic (i.e., number of vehicles on roads), both commercial and administrative, can be expected. Associated with reduced commercial use is the reduction of road reconstruction and best management practices work. Road maintenance activities done in conjunction with commercial use would also occur less often because this work is only required commensurate with use.

Additional timber harvest has the potential to affect recreation experiences and opportunities in several ways. Short-term effects may include increased noise and dust levels, the sight of landscapes altered by differing types of harvesting, the presence of slash piles and roads reconstructed or constructed for timber sales, conflicts with logging trucks on roads used by other Forest visitors, and the removal of snow for winter log hauling from roads frequented by winter recreational users. Users may be temporarily displaced to other locations because of log truck traffic and potential noise and temporary area closures from harvest activities.

New openings in the Forest from vegetation management activities may also create dispersed camping areas over time. In many cases, roads built for logging operations are then used by recreationists, although these roads typically are closed and/or decommissioned after completion of the timber harvest activity. Most likely, currently gated maintenance level 1 roads would be restored to pre-project conditions when harvest activities are completed, especially after salvage operation.

Effects to Sustainable Recreation Opportunities from Wildlife Management

Forest plan wildlife management direction directly affects motorized recreation opportunities, including motorized over-snow vehicle use due to deer and elk winter range. Restrictions that limit types of access and seasonal closures during sensitive periods, such as mating, calving, and when animals emerge from dens, could temporarily displace recreationists to other areas. The Forest’s motor vehicle use map limits motor vehicle use to designated routes or areas, yearlong or seasonally, often in response to wildlife needs.

Recreational benefits from wildlife management could include increased hunter and wildlife viewer satisfaction, as well as maintaining angler satisfaction. The effect on recreation from wildlife management would be the same for all alternatives.

Effects to Sustainable Recreation Opportunities from Threatened and Endangered Species Management

Dispersed recreation opportunities could be affected by management activities related to the Uncompahgre fritillary butterfly due to overlap between dispersed recreation areas and butterfly habitat. Revised management direction across all action alternatives allows dispersed recreation sites to be closed if unacceptable environmental damage occurs. Should Uncompahgre fritillary butterfly habitat experience unacceptable damage from dispersed recreation activities, the amount of available dispersed recreation opportunities on the Forest would decrease due to necessary area closures. Area closures could be temporary or permanent in nature and have a corresponding temporal effect.

Winter recreation opportunities could be affected by management activities associated with Canada lynx. All action alternatives include revised plan direction that directs the Forest to manage winter recreation activities within lynx analysis units such that lynx habitat connectivity is maintained or improved where needed. Over-snow vehicle use suitability determinations may change as a result of shifting priorities concerning lynx habitat over time. If areas currently suitable for over-snow vehicle use become unsuitable, Forest visitors participating in winter motorized recreation could be temporarily or permanently displaced from certain areas. However, because lynx habitat typically consists of dense vegetation, areas deemed unsuitable for over-snow vehicle use on account of lynx habitat may not even be passable for motorized over-snow vehicles. In this case, any effects to winter recreation from lynx habitat management could range from minor to negligible.

Effects on Recreation from Fire Management

Fire and fuels management activities, including prescribed burning, are likely to continue across all alternatives. Fuels management effects on recreation are similar to the effects described under vegetation management. An increase in fire extent, creating a long-lasting change to the setting, could cause a shift in recreation use and displacement to unburned areas. The degree of these effects is difficult to determine and based on the size and intensity of a wildfire event. Prescribed fire has some level of predictability for time, location, and intensity, which may decrease the short- and long-term impacts to Forest visitors. These effects are common to all alternatives.

Fire suppression actions are also likely to continue and could result in the administrative use of gated roads. In some cases, roads that are closed to public motor vehicle use (due to revegetation or other restrictive condition) may be opened in order to facilitate suppression actions. These roads would probably be used for the duration of the suppression efforts and post-fire work and then returned to their previous status.

Effects on Recreation from Mineral Resource Activities

Proposals for mineral exploration and development are driven by external parties and market forces and regulated by existing mining law. Access and road development (long-term or temporary) is often associated with mineral exploration and development, but a site-specific analysis is required prior to any approval for exploration or development activities, including consideration of potential effects to recreation use and values. If any mine reclamation activities occur, those activities would likely use existing roads. These may be roads that are not currently designated for motor vehicle use. They would probably be used for the duration of the reclamation work and then returned to their previous status.

Recreation could be affected by mineral exploration and extraction in all alternatives. Short-term effects may include noise and visual impacts from open-pit or underground mining operations. In the long-term, effects may include: departure from a more naturally appearing landscape, new underground or open pit mines and physical structures, and new roads and road corridors constructed for mining or drilling operations that may change the recreation setting. Mineral facilities could affect Forest visitors depending on the location of development and the setting affected.

Dredging on a recreational basis could impact other recreational opportunities in all alternatives. Short-term effects from dredging on a recreational basis may include noise and visual impacts, sediment and siltation in the river, and temporary water quality impairment. In the long-term, effects may include: ponding in the river, stream channel modification, and potential displacement of wildlife. Dredging activities could affect Forest visitors depending on the location and type of dredging activity, as well as the equipment used.

Cumulative Effects

The analysis area for cumulative effects includes the Forest and adjacent public lands including the Pike-San Isabel, San Juan, Gunnison, Uncompahgre, and Carson National

Forests, Great Sand Dunes National Park and Preserve, several areas managed by the Bureau of Land Management and U.S. Fish and Wildlife Service, Colorado Parks and Wildlife lands, and local parks.

Fiscal capability would present a challenge for existing and new sustainable recreation opportunities on the Forest. The current levels of appropriated funding are inadequate to meet national quality standards for many of the existing developed sites and trails. However, partnerships and volunteers may help bridge that gap, in addition to increasing collaboration and leveraging state and local agency planning efforts. Aligning the Forest's recreation program and available funding with national, statewide, and local efforts could be beneficial.

Anticipated population increases over the course of the planning period would increase demand for a variety of recreation settings, experiences, and opportunities. Although the San Luis Valley has seen an increase of only about 7,000 people since 1996, Colorado's population is anticipated to increase 1.5 percent per year, increasing to more than 7.7 million people by 2040. High growth is expected along Front Range communities, as well as in Durango and Grand Junction.

As densely populated areas continue to grow, lands available for outdoor recreation in those communities would likely become more crowded and less desirable.

Cumulatively, increased use could also increase conflicts among users, as more people are using the same land base. The recreation program will need to evolve with the increase in people and associated demand for recreation opportunities.

Congressionally Designated Trails

Overview

National Scenic and National Historic trails may only be designated by Congress, while National Recreation Trails are administratively designated by the Secretary of Interior or the Secretary of Agriculture. Three nationally designated trails traverse portions of the Rio Grande National Forest. The Continental Divide National Scenic Trail and the Old Spanish National Historic Trail were designated by Congress in 1978 and 2002, respectively. The West Lost Trail, a National Recreation Trail, was designated by the Secretary of Agriculture in 1979. For more information, see the *Nationally Designated Trails* map, which is contained on the DVD located at the back of this document.

Affected Environment, Existing Conditions, and Trends

Old Spanish National Historic Trail

Designated in 2002, this historic trail starts in Santa Fe, New Mexico, and traverses the southwestern United States to southern California, representing the history of commerce in wool and horses during the Colonial Mexican era from 1829 to 1848. The East Fork of the North Branch of the Old Spanish National Historic Trail crosses the San Luis Valley and portions of the Forest, heading north along the flanks of the Sangre de Cristo Mountains and then west up Saguache Creek and over the Continental Divide across two potential variants: Old Cochetopa or New Cochetopa Pass. The Forest hosts at least one high-potential Old

Spanish Trail site called the Bunker Site north of Crestone on the Baca Mountain Special Interest Area.

The Old Spanish National Historic Trail is a unique historic feature in that it does not generally exhibit trail segments and wagon ruts like other historic trails. Considered more of a "concept trail," the congressionally designated corridors that cross the Forest were mule trails meant to evoke the time, setting, and integrity as witnessed during its era of significance. This trail provides opportunities for interpretive stops in the larger heritage tourism context of the San Luis Valley. The trail is administrated by the National Park Service and the Bureau of Land Management. These agencies are charged with the development of a management strategy and comprehensive plan.

Many portions of the trail on the Forest are largely unimpeded by development, and surrounding views remain largely the same as they did when traders passed through. Other sections include visible highways, powerlines, past timber harvest, and grazing improvements. The section of the trail that goes through the newly acquired Baca Mountain Tract is perhaps the most intact in terms of landscape, containing the Bunker Site thought to be a high potential camp (paraje). Much of the trail that crosses the Forest has been inventoried for cultural resources in the recent past.

An important trend of note is an increasing interest from the public in heritage tourism in general, and visiting National Historic Trails in particular. The local La Vereda chapter of the Old Spanish Trail Association is very active in the research and interpretation of the trail.

Continental Divide National Scenic Trail

The 3,100-mile-long Continental Divide National Scenic Trail is a continuous path that follows the backbone of the Rocky Mountains from Canada to Mexico, traversing portions of 20 national forests, 3 national parks, 1 national monument, 13 Bureau of Land Management administrative areas, as well as various state and private lands in the states of Montana, Idaho, Wyoming, Colorado, and New Mexico. About 170 miles of the Continental Divide National Scenic Trail is routed through the Forest, from the northern boundary with the Gunnison National Forest to the New Mexico state line. As described in the comprehensive management plan (USDA Forest Service 2009), the nature and purposes of the Continental Divide National Scenic Trail are to:

- Provide for high-quality scenic, primitive hiking, and horseback riding opportunities, and
- Conserve natural, historic, and cultural resources along the Continental Divide National Scenic Trail corridor.

The Continental Divide National Scenic Trail is the highest national scenic trail, reaching the 14,270 foot summit of Grays Peak. The trail connects the Chihuahuan Desert of New Mexico to majestic conifer forests, remote valleys, and wild, snow-capped mountains and glaciers on the way to its northern terminus in Glacier National Park. Travelers along this path experience the heart of the Rocky Mountain West: untrammeled mountains that stretch to the horizons, plunging streams, snowfields, glaciers, cobalt blue lakes, alpine wildflowers, and quiet camping under star-studded skies. Travelers may also encounter ancient trails, follow the footsteps of Lewis and Clark or early Spanish explorers, trace the routes of the Apache, and follow fresh tracks of grizzlies, wolves, lynx, elk, moose, mountain goats, and wolverines.

The Forest Service is the lead agency responsible for management of the Continental Divide National Scenic Trail. Management is intended to be consistent with the nature and purposes of the trail as described in the 2009 Continental Divide National Scenic Trail Comprehensive Plan, and any revisions.

Direct and Indirect Effects

Alternative A does not have any specific management direction for any congressionally designated trails on the Forest. A comprehensive management plan for the Continental Divide National Scenic Trail, following congressional designation, was completed in 2009 (USDA Forest Service 2009). A comprehensive plan for the Old Spanish National Historic Trail is currently under development. Activities that would substantially interfere with the purpose for which the trails were designated would be avoided to the extent practicable.

Generally, uncontrollable impacts result from public use and vandalism. Natural processes such as wind and water cause soil erosion, and these impacts to the trails would continue to occur. The action alternatives include management activities that include timber management, permitted grazing, prescribed burning, wildlife and fisheries management, facilities construction and maintenance, road and trail construction, recreation use and management, and special uses authorization to third parties.

Alternatives B and C include plan direction that presents a balanced approach to managing these linear features in a multiple use environment. Similar to other alternatives, the direction will continue to contribute to social and economic sustainability in the broader landscape and connect citizens to the land through education, interpretation, stewardship projects, and volunteerism. Effects are anticipated to be positive, resulting in more public understanding of the shared values around both trails, and include the potential for a more educated and stewardship-minded public.

Alternative B includes the trails in the Specially Designated Geographic Area, with the corridor mapped as a linear feature crossing multiple management areas. Alternative C addresses the trails similarly but includes the trails in the Specially Designated Management Area.

Many segments of the Continental Divide National Scenic Trail on the Forest are not located on the Continental Divide. Alternative D establishes the Congressionally Designated Trail Management Area, which in some areas overlaps with existing wilderness and Colorado roadless areas. Alternative D also converts management approaches related to these trails, used as optional plan content in alternative B to facilitate adaptive management, to standards and guidelines. Designating the trail as a management area with related standards and guidelines means that if the trail were proposed to be relocated to the Continental Divide itself, the Forest would have to complete an amendment of the forest plan to do so. Amending the forest plan involves more detailed environmental analysis. Recognizing the trail as a linear feature provides more flexibility to Forest managers to relocate segments of the trail as needed.

Cumulative Effects

Implementation of any of the alternatives could result in short-term impacts that result in long-term benefits. Relocation of trails to improve consistency with historic routes would provide a positive overall experience in the long term. Population increases over time could increase the number of users and therefore impact the trails, and increase user-related conflicts.

Past management of the Old Spanish National Historic Trail may have resulted in fewer intact cultural resources to identify, evaluate, research, and/or interpret. Past and future forest management projects can cause surface disturbance, bring additional people into contact with cultural resources, and affect the integrity of historic structures. Cumulative effects that are the result of ground disturbance associated with implementing each of the alternatives could result in the inadvertent discovery of, and potential damage to, Old Spanish National Historic Trail sites, artifacts, or trail traces. Protection protocols included in all alternatives would mitigate impacts to inadvertent discoveries.

Cultural Resources

Overview

The plan area contains cultural resources that demonstrate human occupation and use for at least the last 12,000 years. Its occupation and use by American Indians with Numic (Ute), Athabascan (Navajo and Apache) and Ancestral Puebloan ethnic affiliation are well documented in ethnographic literature. Occupation and use of the plan area by Anglo-American and other peoples from the Old World have occurred over the past 300 years. The plan area has been under the management of the Forest Service since 1908, slightly more than 100 years. Cultural continuity is a trademark of the San Luis Valley, and by extension, of the Forest. American Indian, Hispanic, and other long-term land-based traditional communities continue to use the Forest for economic, social, recreational, and religious purposes. Cultural resources and historic uses in the plan area are important to understanding the social, economic, and ecological sustainability of the Forest, the State of Colorado, the Rocky Mountain Region, and the Nation as a whole.

Currently, there are approximately 2,099 cultural resources documented in the plan area, defined by the National Historic Preservation Act and by Forest Service Manual 2200, section 2360, as objects or definitive locations of human activity or use, and identifiable through field survey, historical documentation, or oral evidence. Cultural resources have value because they connect one generation to the next, and they are the primary sources of data regarding human interaction with environmental change.

Cultural resources include pre-contact or historic archaeological sites, structures, places, objects, or traditional cultural properties generally 50 years old or older. Some cultural resources have special value as *historic properties:* cultural sites that reflect the past use of the area and are evaluated for *significance* as defined by the National Register of Historic Places under the following criteria: a) association with important events, b) association with important people, c) distinctive historical architectural style, and/or d) potential to yield important information about the past. The process includes identifying historic properties through field inventory, evaluating sites for potential inclusion to the Register, and selecting sites to formally nominate to the Register. Through this effort, current and potential impacts to eligible properties are identified and protection measures designed and implemented. Within the context of the Forest Service's Heritage Program Managed to Standard, these may also be identified as priority heritage assets.

Historic uses such as sheep herding, wood cutting, and big game hunting represent the processes and events important to the identity and history of long-standing land-based communities in the San Luis Valley and tribal communities now living outside of the planning area. Contemporary uses of resources and places within the plan area by American Indian, Hispanic, and Anglo-American communities are critical to maintaining cultural identity. It is worth noting that historic uses can at times have negative impacts on cultural resources, such as the hoof action of overly intensive sheepherding activities on a pre-contact archaeological site.

For more information about the pre-contact, contact, and historic overview of the Forest, see Assessments 12 – Tribal Resources and Assessment 13 – Cultural Resources (USDA Forest Service 2016).

Affected Environment, Existing Conditions, and Trends

A great deal of cultural resource inventory has been conducted and a number of sites have been documented and evaluated for eligibility to the National Register of Historic Places (Table 81) since implementation of the previous forest plan in 1996. A subset of sites has been left unevaluated for significance to the National Register of Historic Places that heritage professionals manage as eligible until proven otherwise.

Table 81. Number of sites evaluated for eligibility to the National Register of Historic Places, 1996 and 2015

Year	Pre-Contact	Historic	Unknown	Eligible	Not Eligible	Unevaluated	Total
1996	456	132	N/A	100	206	282	588
2015	1,523	401	185	304	1,065	730	2,099

A total of 340,231 acres of cultural resource inventory has been implemented, or about 18 percent of the Forest. Cultural resource inventories conducted in the 1970s and early 1980s are sometimes suspect in terms of their adequacy in site identification given the apparent inflated number of acres surveyed by limited crews with less sophisticated tools for tracking survey acres and site locations. To address the substandard quality of some previous surveys, archaeologists conduct sample surveys of older survey areas during new projects to assess accuracy of past surveys and high potential areas and to identify newly exposed sites using a predictive model. More sophisticated tools such as geographic positioning systems units with sub-meter accuracy, geographic information systems location and site mapping, and predictive modeling have made site documentation more accurate and by extension, management more effective in the long term.

The Forest contains a unique array of site types and site distributions that make up the affected environment. Those associated with the pre-contact eras include open lithic (tool stone) scatters, open camps, sheltered architectural sites, open architectural sites, wickiups, tree platforms, culturally modified trees, and rock art. Historic site types include homestead remains, grazing features such as sheep camps, arborglyphs, mining-related features, logging-related features including tie-hacking, roads, stock driveways, railroad beds, and trails. The Forest also contains cultural landscapes, which are groups of sites associated around a theme such as stone tool procurement or mining. Stone features such as game blinds were likely used across the entire spectrum of human use.

In 2011, documentation in Forest Service Manual 2360 created a foundation for a more robust heritage program that protects historic properties while maximizing benefits for both the public and the Agency. The seven key indicators are of a heritage program being managed to standard are:

- program planning,
- cultural resource inventory,
- cultural resource evaluation and official designations,
- condition assessment and allocation,
- stewardship and protection,
- public outreach and benefit, and
- heritage volunteerism.

As part of the condition assessment and allocation measure, the heritage program is expected to designate priority heritage assets, which represent outstanding eligible historic properties. These assets require consistent monitoring in the planning area (Table 82).

Table 82. Priority heritage assets on the Forest, 2017

Description	Smithsonian Number	Forest Service Number
Cumbres & Toltec Scenic Railroad	5CN65	02090300001
Alamosa Ranger Station	5CN756	02090300114
River Springs Work Center	5CN794	02090300118
English Valley Folsom Site	5RN1028	02090400144
Fitton Guard Station	5RN314	02090400145
Off Cow Camp	5RN315	02090400146
Dog Mountain Petroglyphs	5RN330	02090400147
Upper Beaver Creek CCC Outhouse	5RN518	02090400375
Clay Mine Ore Chute	5ML329	02090400609
Black Mountain Folsom Site	5HN55	02090400925
Ivy Creek Prehistoric Site	5ML633	02090401039
Thirty-Mile Resort	5HN1041	02090401078
Rio Grande Reservoir Work Camp	5HN1379	02090401089
Duncan Townsite	5SH3484	02090700145
Mill Creek Stone Structure Site	5SH354	02090700146
Bunker Old Spanish Trail Site	5SH614	02090700147
Kortright Cabin	5SH1300	02090700197
North Tracy Canyon Site	5SH143	02090700229
North Pass Peeled Tree Site	5SH1697	02090700295
Pole Creek Cabin Complex	5SH2383	02090700411
Possible Ute Structure	5SH3927	02090700565
Brewery Guard Station M20 Building	5SH1470	02090700704

Along with eligible historic properties and priority heritage assets, the Forest contains four special interest areas designated for historical significance: the Fremont historic area for 1848 expedition campsites, the Bachelor loop historic area for silver mining sites, the Wagon Wheel Gap watershed experiment station for watershed research features from 1909 to 1926, and the Liberty-Duncan area for pre-contact and mining sites. The Cumbres & Toltec Scenic Railroad in the southern portion of the planning area was designated as a national historic landmark in 2012.

Before the National Historic Preservation Act was enacted in 1966, ground-disturbing activities occurred without cultural resource inventories. In addition, a culture of collecting artifacts and looting sites on the Forest is a well-known local pastime. Natural processes such as water, wind erosion, and fire have negatively impacted a host of site types in different ways. Conversely, the processes of erosion sometimes bury cultural deposits intact, thereby protecting them from some human impacts. Increased heavy fuel loading since the Forest Service began fire suppression in the early 20th century has increased the likelihood of stand-replacing fires that can adversely affect cultural resources. Fire-sensitive sites such as culturally modified trees, wickiups, and cabin structures are especially vulnerable. Increased warming and drought conditions add to the threat. Drought can also precipitate loss of vegetation cover and when added to grazing of domestic and wild ungulates, serious erosion of cultural deposits can occur.

Monitoring eligible historic properties since the last planning cycle revealed negative impacts to cultural resources from permitted grazing, wildland fire, construction and use of illegal mountain bike trails, existing roads, and benign neglect of eligible historic structures. However, the vast majority of eligible historic properties identified within proposed project areas have been successfully avoided and protected with project design criteria. Only one determination of adverse effect that occurred on the Forest in the last planning cycle required a memorandum of agreement with the Colorado State Historic Preservation Office and the Advisory Council on Historic Preservation.

Since the last planning cycle, a greater emphasis has been placed on restoring and maintaining historic structures on the Forest as recreation rentals. These include the Off Cow Camp, the Fitton Guard Station, Duncan Cabin, Brewery Cabin Carnero Guard Station, Elwood Cabin, Alder Guard Station, Stone Cellar, and Upper Crossing Guard Station. The revenue generated from these rentals supports the maintenance and historic integrity of the structures while also playing a part in the heritage tourism in the San Luis Valley.

In addition to the identification and evaluation of cultural resources, the program can take part in the research understanding and protection of living cultures (Table 83). The area is exceptional in terms of its role as a subsistence Forest. Long-term land-based traditional communities of the San Luis Valley have long relied on the Forest to supply forage for sheep and cattle, for wood and plant gathering, and for hunting of wild game. Archaeological sites such as sheep camps and stock driveways are manifestations of activities that continue today. The Forest is critical to supporting local subsistence economies but also to maintaining traditional lifeways and cultures that may continue into the future. For more detailed information on historic uses consult the *Contributions to Social and Economic Sustainability* section and Assessment 6.

Table 83. Cultural resources and historic uses important in and around the planning area

Natural Products		
Tree Products	**Plant Products**	**Additional Products**
Firewood, timber, cottonwood root, pitch, pinyon nuts	Pigments, medicine, oshá, wild tobacco, yucca, chamisa	Mushrooms, earthen pigments, plaster, clay, minerals
Historic Sites		
Historic mining districts, traditional fisheries, traditional recreational/hunting areas		
Ongoing Cultural Uses		
Recreation, fishing, livestock grazing, irrigation, heritage tourism, hunting, labor economy		

Compliance with Section 106 of the National Historic Preservation Act and 36 CFR 800 regulations is required for Forest Service activities and is fulfilled by a process to establish the presence of historic properties in the area of potential effect for each alternative. This process is accomplished through background research, State Historic Preservation Office consultation, and an appropriate level of field investigation. When consultation is conducted, the magnitude of the undertaking, its potential effects, and any alternatives are taken into account as well of the views of the Colorado State Historic Preservation Office/Tribal Historic Preservation Office and other interested parties. Each Forest is required to consult with American Indian tribes with cultural affiliation to the planning area on any project having the potential to affect American Indian sites, including burial and ceremonial sites and practices.

Outcomes to eligible historic properties can be either no adverse effect or adverse effect. A no adverse effect determination could include stabilizing an eligible historic property, for example controlling erosion on an archaeological site, restoring and maintaining an historic building, or reducing fuels concentrations around an historic property. Treatment is designed and agreed upon in consultation with the Colorado State Historic Preservation Officer.

Adverse effects impact the integrity of the property and destroy a portion of, or the entire property. A direct adverse impact occurs during the activity itself, such as site destruction of an historic property caused by road construction activities. Indirect adverse impacts are a side effect of the activity or occur after an activity is complete; for example, the channeling of precipitation runoff by a road that eventually causes the runoff to erode an adjacent historic property. Adverse impacts can be mitigated or avoided altogether through project design. These mitigation or avoidance measures are agreed to in consultation conducted under Section 106 of the National Historic Preservation Act with the Colorado State Historic Preservation Officer and the Advisory Council on Historic Preservation.

Direct and Indirect Effects

Under alternative A, identification, evaluation, nomination, protection, and interpretation of cultural resources would occur. Coordination and consultation with the Colorado State Office of Historic Preservation is also required. Sites eligible for the listing on the National Register of Historic Places must be evaluated and formally nominated. Protection protocols and mitigation measures are used when cultural resources or sacred sites are identified or inadvertently discovered during project activities. The Forest's heritage program addresses known and unknown cultural resources and historic properties and locations of historic significance through management direction in alternative A. The Elephant Rocks Special Interest Area does not include a newly acknowledged traditional cultural property situated on its border. Alternative A also lacks any substantive acknowledgement of traditional historic uses by Hispanic communities and other long-term land-based communities.

Effects might also result from improved access for activities such as recreation and permitted silvicultural projects. Improved access can bring more visitors or contractors to an area, resulting in the potential for increased vandalism. Inadvertent damage and increased noise or visual effects are additional indirect effects. The current allowance of mountain bikers to travel off-trail on the Forest could result in the breakage and displacement of artifacts and negative impacts to features.

Under alternative B, additional objectives and management approaches are tailored specifically for cultural resources. Tiered to these objectives are performance requirements for the completion of inventories, outreach and interpretive projects, site monitoring and protection, and nomination activities for the National Register of Historic Places. Positive effects of all action alternatives include the potential for a more educated and stewardship-minded public. These alternatives adjusts the boundary of the Elephant Rocks Special Interest Area to include an important traditional cultural property, which would reduce the size of the Fremont Historic Area for better ease in management.

Each alternative would continue to contribute to social and economic sustainability in the broader landscape and connect citizens to the land through education, interpretation, stewardship projects, and volunteerism. Effects from this alternative are expected to be positive, resulting in more public understanding of the shared values around cultural resources and historic uses. To balance cultural resource protection and historic uses, this alternative formalizes current practices to maintain significant historic properties for their research potential and historic uses that enable cultural continuity.

Under alternative C, if larger and expedited timber harvest is expected, negative effects on cultural resources could include increased artifact collection by contractors and impacts from more public access and increased erosion from road building. However, the areas proposed in the spruce-fir ecosystems for harvest have the least potential for cultural resources. Similarly if more recreation opportunities are offered under alternative C, indirect effects from recreation management could increase vandalism if new trails are built in areas that have never before been accessed by people, and increased erosion from a higher volume of developed and dispersed sites and trails. If an increase in prescribed burning occurs under alternative C related to increased vegetation management activities, a positive indirect effect to cultural resources could be the removal of fuel loads around fire-sensitive sites, thereby decreasing the effects of catastrophic fire.

Under alternative D, given its emphasis on conservation, effects to and potential inadvertent discoveries of cultural resources from management activities would be expected to decrease. Moreover, positive effects of wilderness, wild, scenic, and recreational river, and research natural area designations would be decreased management activities and by extension, fewer potential impacts to cultural resources. Potential increases in wildfires managed for resource benefit, could result in negative effects to undocumented cultural resources.

Effects to Cultural and Heritage Resources by Management of Other Resources

Effects from livestock management common to all alternatives include trailing along fence lines and loafing of cattle around water developments. Effects on cultural resources from road management, construction, and reconstruction would include altering drainage patterns that may result in erosion. Purchase or exchange of often has positive effects on cultural resources. Cultural resources are afforded more protections when the land is federally managed. Negative effects could include the potential for increased vandalism. Effects of wildland fire could include the exposure of artifacts to vandalism, erosion, and grazing of wild and domesticated ungulates seeking the fresh regrowth as well as loss of the resource. Mineral extraction impacts are expected to be similar to those from increased timber harvest and recreation.

All action alternatives would have some potential commitments of non-renewable cultural resources. Examples are inadvertently damaged and destroyed sites, vandalized or looted sites, or as yet undiscovered sites that are undergoing loss from natural forces. Every alternative seeks to reduce this loss through inventory, monitoring, project evaluation, and improved project implementation to assure that loss is kept to a minimum.

Cumulative Effects

The loss of cultural resources generally occurred before better research methods were developed. Before the advent of the National Historic Preservation Act, previous management (or the lack thereof) resulted in cultural resources being unprotected, which typically rendered the resources as not eligible for inclusion in the National Register of Historic Places. Past and future forest management projects can cause surface disturbance, bring additional people into contact with cultural resources, and affect the integrity of historic structures.

Over time, additional range improvements and domesticated ungulate grazing, especially in early springtime, could result in adverse cumulative effects to cultural resources. Population growth and public desire for new recreational experiences in conjunction with trail development on bordering Bureau of Land Management lands could result in adverse cumulative effects to cultural resources.

Alternatives that result in more acres of management activities would result in increased acres of inventory. The additional required inventory and evaluation would result in more cultural resources being documented and protected from adverse effects caused by natural processes.

Ground disturbance associated with implementing all alternatives may result in the inadvertent discovery of and potential damage to cultural resources or sacred sites. Protection protocols are in place under all alternatives to mitigate impacts to inadvertent discoveries of cultural resources and sacred sites.

Wilderness

Overview

The 1964 Wilderness Act defined wilderness as a place "in contrast with those areas where man and his own works dominate the landscape… where earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain… an area of undeveloped Federal land retaining its primeval character and influences, without permanent improvements or human habitation, which is protected and managed to preserve its natural condition and which:

- Generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable,
- Has outstanding opportunities for solitude or a primitive and unconfined type of recreation,
- Has at least 5,000 acres or is of sufficient size to make practicable its preservation and use in an unimpaired condition, and
- May also contain ecological, geologic, or other features of scientific educational, scenic, or historic value."

The Wilderness Act requires the preservation of wilderness character and recognizes the multiple values and public benefits found in these areas. Wilderness provides outstanding opportunities for solitude and for primitive and unconfined recreational experiences. Wilderness is also important for maintenance of species diversity, protection of threatened and endangered species, protection of watersheds, scientific research, and various social values.

The Colorado Wilderness Act, Colorado Wilderness Act of 1993, and Public Law 93-632 assisted in the congressional designations of wilderness on the Forest. Currently the Forest contains about 12 percent of designated wilderness lands in Colorado, and about 1 percent of designated wilderness in the National Wilderness Preservation System.

Affected Environment, Existing Conditions, and Trends

Wilderness areas provide a wide variety of user opportunities for exploration, solitude, risk, and challenge, and for primitive and unconfined recreation in a natural setting. Designated wilderness represents the highest concentration of quiet places where sights and sounds of human presence are relatively unnoticeable. Primary recreational activities in wilderness areas include hiking, horseback riding, hunting, and fishing. Outfitting and guide services, to the extent necessary, are offered to visitors in wilderness areas.

The existing wilderness areas are managed to preserve the wilderness character of the areas. Five qualities describe wilderness character:

1. **Untrammeled.** Wilderness is essentially unhindered and free from modern human control or manipulation.
2. **Naturalness.** Wilderness ecological systems are substantially free from the effects of modern civilization.
3. **Undeveloped.** Wilderness is essentially without permanent improvements or modern human occupation.
4. **Outstanding opportunities for solitude or a primitive and unconfined type of recreation.** Wilderness provides outstanding opportunities for people to experience solitude or primitive and unconfined recreation, including the values of inspiration and physical and mental challenge.
5. **Other features of value.** Wilderness may contain ecological, geologic, or other features of scientific educational, scenic, or historical value.

The national visitor use monitoring program has monitored visitor use every 5 years of the Forest from 2005 to 2015. Use levels in designated wilderness on the Forest increased from 35,000 in 2010 to 39,000 in 2015. This monitoring does not separate out use within the four designated wilderness areas. This is about 5 percent of total visits to the Forest for 2010.

Designated wilderness comprises an estimated 21 percent of the Forest, or approximately 392,402 acres (official and other acres). The La Garita, Sangre de Cristo, South San Juan, and Weminuche Wildernesses all occur within and around the Forest.

La Garita Wilderness

Designated in 1964, the La Garita Wilderness was expanded in 1980 through The Colorado Wilderness Act (Public Law 96-560, December 22, 1980) and was again expanded in 1993 through the Colorado Wilderness Act of 1993 (Public Law 103-77, August 13, 1993). The wilderness encompasses an estimated 126,480 acres of National Forest System lands within both the Rio Grande and the Gunnison National Forests. Elevations range from a low of 9,000 feet to a high of 14,014 feet on San Luis Peak Summit, which provides stunning views across the Upper Rio Grande Valley and down the long stretch of the San Luis Valley. This wilderness includes the Wheeler Geologic Area, an unusual geologic formation composed of fine, light gray volcanic ash compressed into rock and wildly eroded into a striking series of domes, spires, caves, ledges, pinnacles, ravines, and balanced rocks. A four-wheel drive road provides motorized access to within one-half mile of the wilderness boundary.

Sangre de Cristo Wilderness

The Sangre de Cristo Wilderness was designated in 1993 through the Colorado Wilderness Act of 1993 (Public Law 103-77, August 13, 1993) and was reduced in size through the Great Sand Dunes National Park and Preserve Act of 2000 (Public Law 106-530, November 22, 2000). The wilderness originally encompassed approximately 219,776 acres and has since been reduced to approximately 179,225 acres of National Forest System lands within both the Rio Grande and San Isabel National Forests. On November 22, 2000, through the Great Sand Dunes National Park and Preserve Act, 40,595 acres of the original Sangre de Cristo Wilderness was converted to the Great Sand Dunes Wilderness, administered by the National Park Service.

South San Juan Wilderness

Designated in 1980 through the Colorado Wilderness Act (Public Law 96-560, December 22, 1980) he South San Juan Wilderness was expanded in 1993 through the Colorado Wilderness Act of 1993 (Public Law 103-177, August 13, 1993). The South San Juan Wilderness encompasses an estimated 161,009 acres within both the Rio Grande and the San Juan National Forests.

Weminuche Wilderness

Congress designated the Weminuche Wilderness in 1975 under the Designation of Wilderness Areas within the National Wildlife Refuge System Act of 1975 (Public law 93-632, January 3, 1975). It was expanded to its current size by the Colorado Wilderness Act of 1980 (Public Law 96-560, December 22, 1980) and Colorado Wilderness Act of 1993 (Public Law 103-77, August 13, 1993). The Weminuche Wilderness currently encompasses approximately 500,268 acres within both the Rio Grande and San Juan National Forests.

Direct and Indirect Effects

Alternative A separates wilderness areas into three separate management areas: Wilderness – Pristine (1.11), Wilderness – Primitive (1.12), and Wilderness – Semiprimitive (1.13). Alternatives B through D propose combining all acres into one management area that combines all of the forest plan direction from the three separate management areas into one. Management in wilderness would not change based on the combination of management areas. This combination is also not expected to decrease protection of wilderness resources and characteristics.

Natural, unplanned wildland fire ignitions would continue the long-term ecological processes in these areas. There could be a temporary loss of vegetation, potentially a reduction in water quality due to sedimentation, and a short-term increase in air pollution. These effects are part of the natural ecological processes that are promoted in wilderness.

Effects to Wilderness from Trails Management

Trail management activities occur in wilderness. Methods used to maintain and manage trails comply with wilderness direction that restricts the use of mechanized equipment. The use of cross-cut saws and hand tools is required in wilderness, because the use of power tools would detract from the primitive experience that visitors to wilderness seek. At the most pristine areas of wilderness, far from modern developments, no trails exist and travel is cross-country, with routes marked by historical cairns. Some user-developed trails may be evident as visitors travel through. Some other areas may have developed trails with directional signs. Trail maintenance and management would not have any impact on wilderness values or characteristics.

Wilderness provides dispersed recreation opportunities. Use of wilderness throughout the Forest is relatively low, with areas concentrated use in popular destinations. There would be no effect to designated wilderness from dispersed recreation.

Acres of recommended wilderness would expand the amount of wilderness available and would increase the opportunity for wilderness experiences. Expansion of wilderness boundaries and increased management would occur if the recommended wilderness in alternatives B and D are recommended to Congress for designation.

Designation of suitable or eligible wild, scenic, and recreational rivers would adhere to methods of management techniques that are acceptable in designated wilderness areas. There would be no effect to designated wilderness from wild, scenic, and recreational river designation.

Research natural area and special interest area designation would adhere to methods of management techniques that would be acceptable in wilderness areas. There would be no effect to designated wilderness from research natural area designations.

Wilderness areas are all currently withdrawn from mineral extractions, therefore there would be no effect to designated wilderness, wilderness experiences, or wilderness characteristics from mineral extraction.

Cumulative Effects

Generally, wilderness areas represent a more natural vegetation condition (i.e., composition, structure) than non-wilderness areas. These large tracts of land, relatively free of human-caused disturbances, allow natural ecological processes and disturbances to be the primary forces. Therefore, they contribute to maintaining biological diversity while minimizing the effects of human development on habitat connectivity. These wilderness areas have played a role in maintaining strongholds of a number of threatened, endangered, and sensitive species such as lynx.

Population growth and development increases the need for public open space. Growth in the San Luis Valley and adjacent areas would likely increase public use of the Forest, including wilderness. Increased recreation use may impact the wilderness character, particularly the opportunity for solitude and natural quality. Examples of potential impacts include increased crowding in high use areas, soil compaction or erosion, and threats to native plant species from the spread of noxious weeds from sources outside the wilderness. The cumulative effects of urbanization and population growth on wilderness use and resource conditions are likely to be gradual and extend well beyond the planning period. Management of adjacent designated wilderness by the Bureau of Land Management and other national forests would be consistent with management of wilderness by the Forest and would minimize the likelihood of adverse cumulative effects from neighboring jurisdictions.

Recommended Wilderness

Overview

The wilderness recommendation process occurs in four primary steps: inventory, evaluation, analysis, and recommendation. All plan revisions must complete this process before the responsible official determines whether to recommend lands in the plan area to Congress for wilderness designation. Maps showing *Recommended Wilderness for Alternatives B and D* are contained on the DVD located at the back of the document.

Affected Environment, Existing Conditions, and Trends

The demand for wilderness goes beyond recreation opportunities. Other values include long-term environmental monitoring, scenic backdrops for tourism, watershed protection, and maintenance of biological diversity. Many people who do not regularly visit primitive, roadless, or designated wilderness areas still value protection of such areas to maintain the opportunity for visits in the future (option value). People also gain benefits simply from knowing that natural areas exist (existence values) and that their protection today sustains them for future generations (bequest value) (Rosenberger and Loomis 2001).

Several studies have shown the importance and value people place on these passive use benefits of wilderness (Cordell et al. 1999). These values or needs are reflected in the National Survey on Recreation and the Environment finding that an estimated 70 percent of those surveyed agreed or strongly agreed to the question, "How do you feel about designating more Federal lands in your state as wilderness?" More than 96 percent agreed or strongly agreed with the statement, "I enjoy knowing that future generations will be able to visit and experience wilderness areas."

Wilderness provides outstanding opportunities for solitude and for primitive and unconfined recreational experiences. Wilderness is also important for maintenance of species diversity, protection of threatened and endangered species, protection of watershed, scientific research, and various social values. Wilderness is part of the national forest multiple use management mission.

The areas below are being recommended for inclusion in the National Wilderness Preservation System. These areas were carried forth following completion of the inventory and evaluation phases of the wilderness recommendation process in compliance with the 2012 Planning Rule. During the inventory and evaluation process, the area polygons were numbered to allow for reference to the Draft Wilderness Inventory and Evaluation Report (USDA Forest Service 2016). Since that time, those polygons have been further described in relation to their geography and status under the Colorado Roadless Rule. A crosswalk for identifying areas of recommended wilderness with the polygons resulting from the wilderness inventory and evaluations processes is provided in Table 84.

Table 84. Wilderness area crosswalk

Suggested Wilderness Name	Polygons identified in Wilderness Evaluation	Associated Colorado Roadless Area	Ranger District
Antora Meadows / Bear Creek	6	Antora Meadows / Bear Creek	Saguache
Beartown / Indian Ridge	29	Beartown, Indian Ridge	Divide
North Fork / Rock Creek	51	Bennett Mountain / Blowout / Willow Creek / Lion Point / Greenie Mountain	Divide
Bristol Head	26	Bristol Head	Divide
Conejos River / Lake Fork	61	Conejos River / Lake Fork	Conejos Peak
Cumbres	63A	Cumbres	Conejos Peak
Elkhorn	4	Elkhorn	Saguache
Pole Mountain / Finger Mesa	28	Pole Mountain / Finger Mesa	Divide
Saguache Park	12	Taylor Canyon, Four Mile Creek	Saguache
Sangre de Cristo	1A, 2, 3A, 3B, 3C, 3D, 3E, 3F	Pole Creek, Creston, Cotton Creek, Hot Springs, Miller Creek, Butterfly	Saguache / Conejos Peak
Sawlog	15	Sawlog	Saguache
Snowshoe Mountain	38A	Snowshoe Mountain	Divide
Tobacco Lakes / Gold Creek	57, 55	Tobacco Lake, Gold Creek / Cascada Creek	Conejos Peak
Wannamaker	20A	Lake Fork, Sheep Mountain, Deep Creek / Boot Mountain	Saguache
Wason Park / Lower East Bellows	25A, 25B	Wason Park, Lower East Bellows	Divide

More information and detailed descriptions of each wilderness area are contained in Appendix A. The descriptions are a product of the public and internal inventory and evaluation phases of that process, as well as a review of scoping comments received in the fall of 2016. The areas of recommended wilderness as they correspond with Colorado roadless areas as designated in the 2012 Roadless Rule are shown in Table 85.

Table 85. Areas of recommended wilderness in alternatives B and D

Name of Recommended Wilderness Area (Associated Colorado Roadless Areas)	Alternative B				Alternative D			
	Total Recommended Wilderness (acres)	Colorado Roadless in the Recommended Wilderness Area (acres)			Total Recommended Wilderness (acres)	Colorado Roadless in the Recommended Wilderness Area (acres)		
		Roadless	Upper Tier	Total Roadless		Roadless	Upper Tier	Total Roadless
Antora Meadows/Bear Creek	0	0	0	0	21,480	3,360	17,310	20,670
Beartown/Indian Ridge	6,750	360	3,640	4,000	5,460	3,260	350	3,610
North Fork/Rock Creek (Bennett Mountain/Blowout/Willow Creek/Lion Point/Greenie Mountain)	0	0	0	0	17,140	3,670	12,260	15,930
Bristol Head	0	0	0	0	39,330	10,300	38,940	49,240
Conejos River/Lake Fork	1,020	870	0	870	1,020	870	0	870
Cumbres	7,490	2,200	4,480	6,680	7,490	2,200	4,480	6,680
Elkhorn Peak	0	0	0	0	15,180	1,730	8,780	10,510
Wannamaker (Lake Fork/Sheep Mountain/ Deep Creek/ Boot Mountain)	0	0	0	0	18,140	8,580	9,490	18,070
Pole Mountain/Finger Mesa	0	0	0	0	31,260	3,740	27,520	31,260
Saguache (Four Mile Creek/ Taylor Canyon)	0	0	0	0	23,040	90	14,050	14,140
Sangre De Cristo	35,090	12,040	0	12,040	35,090	12,040	0	12,040
Sawlog	0	0	0	0	16,240	1,660	8,780	10,440
Snowshoe Mountain	0	0	0	0	30,220	8,600	21,470	30,070
Tobacco Lakes/ Gold Creek (Tobacco Lakes/Gold Creek/Cascada Creek)	2,510	10	2,110	2,120	3,030	30	2,780	2,810
Wason Park/Lower East Bellows	0	0	0	0	21,770	4,030	17,640	21,670
Total	52,860	15,480	10,230	25,710	284,870	63,290	183,850	247,140

Effects on Areas of Recommended Wilderness from Timber Harvest

These lands are not suitable for timber production and timber harvest is not allowed. Most lands in recommended wilderness are within Colorado roadless areas that have high to outstanding wilderness characteristics, primarily due to a lack of motorized use and timber harvesting not occurring in much of these areas. Therefore, there are very few acres in recommended wilderness where timber production would have been considered suitable.

Effects on Areas of Recommended Wilderness from Fire Management

Effective fire suppression, insect and disease infestations, and native vegetation and fuel types on the Forest create fuel conditions that could support moderate to high severity wildfires in some areas. Lightning-caused wildfires may be managed to meet resource benefits to trend vegetation toward desired conditions. Likewise, wildland fire for restoration purposes may be used to trend vegetation toward the desired conditions.

The use of natural, unplanned ignitions would be more likely in alternatives B and D, which emphasize the use of natural disturbances and have the highest and the second highest acreage of recommended wilderness. The use of natural, unplanned ignitions would continue the long-term ecological processes in these areas. There could be substantial changes in existing forest cover, reduction in water quality due to sedimentation, and air pollution; however, these effects are natural ecological processes. The opportunity to use natural, unplanned ignitions within some of the recommended wilderness would be limited due to the shape, size, and location of the wildfire relative to values at risk, should a wildfire occur.

Recommended wilderness is suitable for restoration activities where the outcomes will protect the wilderness characteristics of the areas as long as the ecological and social characteristics that provide the basis for each area’s suitability for wilderness recommendation are maintained and protected. Wildland fire for restoration purposes could affect the natural quality and solitude wilderness characteristics, especially where crews are burning or monitoring burns.

Effects on Areas of Recommended Wilderness from Livestock Grazing

Livestock grazing activities would continue within recommended wilderness in areas where grazing was established prior to wilderness designation. Management activities associated with livestock grazing would have to conform to the management direction associated with wilderness areas.

Effects on Areas of Recommended Wilderness from Road Construction and Reconstruction

New road construction or reconstruction is not suitable in recommended wilderness areas, limiting the amount of new access on the Forest. Alternative D would have the largest amount of area not suitable for new roads or road reconstruction, followed by alternative B. Alternatives A and C have no recommended wilderness.

Effects on Areas of Recommended Wilderness from Road Management

There are no roads within the areas of recommended wilderness. All roads were cherry stemmed to avoid conflict and access to inholdings that may be present within the areas. There will be no effect from road management on recommended wilderness.

Effects on Areas of Recommended Wilderness from Motorized Off-Highway Travel

Motorized off-highway travel is not suitable in recommended wilderness areas. Motorized off-highway travel areas would have to be converted to nonmotorized areas in recommended wilderness areas. Alternative D would have the largest amount of area not suitable for new motorized off-highway travel and would reduce existing motorized off-highway travel, followed by alternative B. Alternatives A and C have no recommended wilderness.

Effects on Areas of Recommended Wilderness from Trail Management

Trail management would still be authorized in recommended wilderness areas. Motorized trails would not be authorized and would have to be converted to nonmotorized trails. Mountain bike trails would be allowed if previously authorized and would only be discontinued if congressional designation of wilderness occurred. Mountain biking would not be allowed to expand with new trail construction or to increase beyond the current use and location in recommended wilderness areas. Alternative D would have the largest amount of area not suitable for new motorized trail construction and would reduce the amount of current motorized trails on the Forest, followed by alternative B. Alternatives A and C have no recommended wilderness.

Effects on Areas of Recommended Wilderness from Developed Recreation

Developed recreation facilities that provide user comforts such as picnic tables, fire grills, and vault toilets are not a suitable use in recommended wilderness. These areas are generally in the primitive recreation opportunity spectrum setting where predominantly unmodified landscapes and are managed for quiet solitude away from roads, people, and development. Alternative D would have the largest amount of area not suitable for recreation facilities that provide user comforts, followed by alternative B. Alternatives A and C have no recommended wilderness.

Effects on Areas of Recommended Wilderness from Wildlife Management

Recommended wilderness areas are characterized by a natural environment where ecological processes such as natural succession, wildfire, avalanches, insects, and disease function with limited human influence. Impacts from visitation do not detract from the natural setting. However, recommended wilderness is suitable for restoration activities where the outcomes will protect wilderness characteristics as long as the ecological and social characteristics that provide the basis for each area’s suitability for wilderness recommendation are maintained and protected. Restoration activities or management activities for wildlife and fish could include monitoring, relocation of animals, habitat improvements such as removal of nonnative fish species, and stream improvements.

Management for wildlife and fish may occur in recommended wilderness areas as long as wilderness characteristics, and the ecological and social characteristics that provide the suitability for inclusion into the National Wilderness Preservation System, are protected and maintained for alternatives B and D.

Effects on Areas of Recommended Wilderness from Designation of Wild, Scenic, and Recreational Rivers

Designated wild, scenic, and recreational rivers are present in recommended wilderness areas. These areas would be suitable for restoration activities where the outcomes would protect the wilderness characteristics as long as the ecological and social characteristics that provide the basis for each area's suitability for wilderness recommendation are maintained and protected. Restoration activities could include restoration of streambanks, which could consist of prescribed burning, planting of native vegetation, thinning with an emphasis on hand thinning over mechanical, and protecting tree cover from loss due to fire, bark beetles, or other stressors. Control of invasive plant species by hand pulling and herbicide spraying also could take place.

Effects on Areas of Recommended Wilderness from Designation of Research Natural Areas and Special Interest Areas

Research natural areas and special interest areas are present in areas of recommended wilderness. These areas would be suitable for restoration activities where the outcomes would protect the wilderness characteristics of the areas as long as the ecological and social characteristics that provide the basis for each area's suitability for wilderness recommendation are maintained and protected. Restoration activities could include restoration of streambanks, which could consist of prescribed burning, planting of native vegetation, thinning with an emphasis on hand thinning over mechanical, and protecting tree cover from loss due to fire, bark beetles, or other stressors. Control of invasive plant species by hand pulling and herbicide spraying also could take place.

Effects on Areas of Recommended Wilderness from Mineral Resource Activities

Recommended wilderness areas are not withdrawn from mineral entry and are available for new leases or claims as long as the social and ecological characteristics that provide a basis for wilderness designation are maintained and protected. The proposed action must preserve and protect wilderness character. Therefore the effects of mineral management would be the same with all alternatives and the social and ecological characteristics that form the basis of wilderness designation would be protected and maintained.

Cumulative Effects

Reasonable and foreseeable future programmatic actions on National Forest System and adjacent lands include vegetation management, minerals management, and ski area and other recreation management. These programmatic actions could affect the wilderness characteristics and opportunities for solitude, depending on scope and scale of the actions. Observations of sights and sounds within the recommended wilderness area are typically used to determine effects to wilderness characteristics. For example, vegetation management activities such as harvesting timber adjacent to recommended wilderness may increase the sights and sounds of logging equipment such as chainsaws and skidders in areas of recommended wilderness; however, because it is outside the recommended wilderness area, it is not considered to degrade the wilderness characteristic of solitude.

Population growth in Colorado is likely to increase recreational use of the Forest, including an increase in use of recommended wilderness areas. The effects of urbanization and population growth on recommended wilderness and resource conditions are likely to be gradual and extend well beyond the planning period. Increased recreational use may adversely impact the wilderness characteristics, particularly the opportunity to experience solitude and natural quality. Currently, the Forest contains about 12 percent of the congressionally designated wilderness in Colorado, and less than 1 percent of the wilderness in the National Wilderness Preservation System. Six recommended wilderness areas on the Forest are adjacent to other national forests. The Beartown/Indian Creek recommended wilderness area is adjacent to the San Juan National Forest. The Pole Mountain/Finger Mesa, Bristol Head, Wason Park/Lower East Bellows, Wannamaker, and Antora Meadows/Bear Creek areas are adjacent to the Grand Mesa, Uncompahgre, and Gunnison National Forests. Management of adjacent designated wilderness by the Bureau of Land Management and other national forests would be consistent with management of wilderness by the Forest and would minimize the likelihood of adverse cumulative effects from neighboring jurisdictions.

Wild, Scenic, and Recreational Rivers

Overview

The National Wild and Scenic Rivers System was created by Congress in 1968 (Public Law 90-542) to preserve certain rivers with outstanding natural, cultural, and recreational values in a free-flowing condition for the enjoyment of present and future generations. The Wild and Scenic Rivers Act is notable in that it seeks to protect these rivers while at the same time acknowledging the benefits and necessity of appropriate developments within the river corridor. To be designated under the Act a river segment must meet two fundamental requirements: the river segment must be “free-flowing” as defined by Section 16(b) of the Act, and the river segment must have one or more outstandingly remarkable values (Section 1(b)).

Rivers may be designated by Congress or, if certain requirements are met, by the Secretaries of the Interior or Agriculture, as appropriate. Once designated under the Act, rivers receive special management direction that ensures the maintenance of the free-flowing nature, water quality, and outstanding natural, cultural, and recreational values of the river segment. The Wild and Scenic Rivers Act Section 5(d)(1) requires that “consideration shall be given by all Federal agencies involved to potential national wild, scenic and recreational river areas” during land management planning. Rivers that have been inventoried and determined to meet the requirements of the Act, but that have not yet been designated, are considered to be either eligible or suitable (those that have been recommended to Congress and the President). These eligible and suitable segments are managed to maintain their free-flowing nature, outstandingly remarkable values, and water quality until such time as they are designated under the Act or released from consideration.

Across the United States, a total of 12,733 miles is designated under the Wild and Scenic Rivers Act, representing less than 1 percent of the Nation's rivers.

Affected Environment, Existing Conditions, and Trends

In 1975, Public Law 93-621 amended the original Wild and Scenic Rivers Act and directed that the three tributary forks of the Conejos River, as well as the main stem of the Conejos (excluding Platoro Reservoir) to its crossing of Highway 17 be studied for potential inclusion in the National Wild and Scenic Rivers System. In 1979, following substantial efforts, recommendations regarding the Conejos River were made to the Secretary of Agriculture from the State of Colorado and the Forest Service. The recommended wild river segments were: El Rito Azul, the North, Middle, and South Forks of the Conejos, and the main stem of the Conejos from Three Forks to Platoro Reservoir. Additionally, the main stem of the Conejos from the Town of Platoro to the confluence with South Fork of the Conejos was recommended as a recreational river segment. No legislative action has yet been taken on these recommendations.

In addition to the congressionally directed study reaches discussed above, the Forest conducted an eligibility evaluation of remaining stream segments as part of the forest plan revision process. Those streams are shown as either eligible or suitable in Table 11 of Chapter 2 of the Rio Grande Draft Revised Land Management Plan. These segments have been managed to maintain the existing free-flowing conditions, water quality, and outstandingly remarkable values that led to their eligibility or suitability determination in the 1996 forest plan. As a result, resource conditions pertinent to the Wild and Scenic Rivers Act have not appreciably changed and existing uses and conditions within eligible and suitable river corridors are consistent with maintenance of these segments until they are either designated under law, or released from consideration.

As a result of the Great Sand Dunes National Park and Preserve Act of 2000, the eligible segments of Medano and Little Medano Creeks have been transferred to management by the National Park Service and are no longer under the jurisdiction of the Forest. Consequently, future eligibility, suitability, and declaration activities for these reaches will be handled by the National Park Service. A map showing *Wild, Scenic, and Recreational Rivers for Alternatives B, C, and D* is contained on the DVD located at the back of this document.

Direct and Indirect Effects

River segments that have been determined to be eligible or suitable for inclusion in the National Wild and Scenic Rivers System are subjected to additional management constraints during project analysis. The responsible official may authorize site-specific projects and activities on National Forest System lands within river corridors that are eligible or suitable. Such projects include certain types of mineral development, water development, road and trail construction, rights-of-way or easements for utilities, recreational developments, motorized travel, fish and wildlife management projects, vegetation management including weed control, and livestock grazing. These uses, however, must be managed, designed, or regulated to protect the free-flowing character, water quality, outstandingly remarkable values, and recommended classification of the reach on which they occur.

All alternatives include management direction, such as desired conditions, objectives, standards, and guidelines, to ensure that projects do not compromise the future potential of eligible and suitable reaches to be designated under the Wild and Scenic Rivers Act. Under alternative A, all previous eligible and suitable reaches are carried forward in their current state, with the exception of those segments of Medano and Little Medano Creeks that have been transferred to the National Park Service. Alternative A contains about 115 miles of suitable or eligible streams, distributed as shown in the Table 11 of Chapter 2 of the Rio Grande National Forest Draft Revised Land Management Plan. Management areas surrounding these river segments total about 30,000 acres. Alternatives B, C, and D are identical with respect to proposed eligible and suitable river segments. These alternatives include all reaches contained in alternative A and propose that a portion of Deadman Creek, flowing from the Sangre de Cristo range, be included as a scenic reach. Alternatives B, C, and D propose approximately 117 miles of eligible and suitable rivers, with an estimated 34,576 acres of river corridor, and would provide the most protection by river miles and acres.

All alternatives would likely have similar impacts from a wide variety of management activities, due primarily to protective forest plan components that maintain river corridor conditions until designation under the Wild and Scenic Rivers Act, or release from consideration.

Effects on Eligible and Suitable Wild, Scenic, and Recreational Rivers from Vegetation Management

Eligible or suitable reaches with a wild or scenic classification have been removed from the suitable timber base, and cutting of trees and other vegetation is not permitted except when needed in association with a primitive recreation experience, to protect users, or to protect identified outstandingly remarkable values. Examples of such exceptions include activities to maintain trails or suppress wildfires. For eligible or suitable river reaches with recreational classifications, a range of vegetation management and timber harvest practices are allowed, if these practices are designed to protect users, or protect, restore, or enhance the river environment, including the long-term scenic character.

Impacts to eligible or suitable reaches from timber harvest and vegetation management would be unlikely to vary significantly by alternative due to the large overlap between the alternatives, and the fact the additional river corridor acreages under alternatives B, C, and D are mostly outside of suitable timber base.

Effects on Eligible and Suitable Wild, Scenic, and Recreational Rivers from Livestock Grazing

The continuation of livestock grazing may have little impact on eligible or suitable reaches. Outstandingly remarkable values have been maintained under current grazing management, and no changes are expected if rivers are found eligible or suitable. Most wild, scenic, and recreational river corridors have some acres of range allotments within them; however, standards and guidelines are in place that have maintained suitable conditions in river corridors. If new facilities are needed for livestock management, they would be designed to fit into the classification. The impacts related to livestock grazing on eligible or suitable reaches would be similar for all alternatives.

Effects on Eligible and Suitable Wild, Scenic, and Recreational Rivers from Roads and Trails

The vast majority of the proposed eligible and suitable river reaches have been in place since 1996. Travel management policies in the designated corridors surrounding these reaches are anticipated to continue to be consistent with past management practices. These practices have maintained the outstandingly remarkable values, water quality, and classification of these reaches since 1996. The proposed reach on Deadman Creek under alternatives B, C, and D is classified as scenic and has two road access points, which are consistent with both the scenic classification and outstandingly remarkable values. If future road or trail development were to occur in the protected river corridors, such development would be consistent with the outstandingly remarkable values and classification of each river reach. The impacts to wild, scenic, and recreational rivers from roads and trails is not expected to vary significantly by alternative due to the similar number of river miles and acres protected.

Effects on Eligible and Suitable Wild, Scenic, and Recreational Rivers from Recreation

Designation of special recreation areas draws the public, thereby increasing usage of and visits to the area. This could create impacts to the area from these uses. Uses have not increased from designations eligibility and suitability in the 1996 forest plan. The inclusion of Deadman Creek is not anticipated to increase use in this area because of the remoteness of the area and difficult access. Therefore, no increased impacts are expected under any alternative.

Effects on Eligible and Suitable Wild, Scenic, and Recreational Rivers from Water Diversions and Water Development Projects

Given the heavily over-appropriated nature of Colorado Water Division 3, and the presence of existing federal reserved instream flow rights, it is unlikely that new water resource developments will have impacts to eligible and suitable reaches under any alternative.

Effects on Eligible and Suitable Wild, Scenic, and Recreational Rivers from Designation of Wilderness, Research Natural Areas, Special Interest Areas, and Scenic Trails, and Byways

Overlapping management direction is discussed in Chapter 2 and in the *Recommended Wilderness* section.

Effects on Eligible and Suitable Wild, Scenic, and Recreational Rivers from Mineral Resource Activities

Minerals development, consistent with the required guidelines, may result in localized, decreased vegetation in the riparian corridor, and small and/or temporary increases in sedimentation. These activities are not expected to impact the outstandingly remarkable values or water quality of eligible or suitable reaches. The impacts related to minerals management on eligible and suitable reaches would be similar under all of the alternatives, although alternatives B, C, and D have more potential for conflict due to the larger number of acres and miles protected.

Cumulative Effects

Public participation in water-based recreation activities such as fishing, rafting, and kayaking will continue to increase as population and development increase throughout the state. There has been a steady increase in water-based recreation activities on rivers that flow predominantly through National Forest System lands. The effects of population growth and associated increased water-based recreation use are likely to be gradual and extend well beyond the planning period.

Management activities on the Forest that result from implementation of any of the four alternatives would be directed to adhere to protective forest plan components that maintain river corridor conditions. Any management activities that take place within eligible and suitable wild, scenic, and recreational river corridors would be consistent with maintaining the free-flowing nature, identified outstandingly remarkable values, and water quality of river segments. For example, if invasive weeds were discovered in an eligible river corridor, action (hand-pulling or herbicide application) may be taken to remove the weeds to prevent further spread within the corridor.

Cumulative effects to wild, scenic, and recreational rivers from implementation of any of the four alternatives are not considered significant at the programmatic scale.

Roadless Areas

Overview

The 2012 Colorado Roadless Rule created 53 roadless areas on the Forest that consist of approximately 518,620 acres. This acreage differs in what is shown in Table 2 in Chapter 2 due to geographic information system discrepancies. Most of these areas were considered “backcountry” in the previous forest plan. The Colorado Roadless Rule provides management direction for conserving and managing roadless areas on National Forest System lands in Colorado.

Affected Environment, Existing Conditions, and Trends

The Colorado Roadless Rule was initiated to refine and update the Roadless Area Conservation Rule. The final Rule provides for management of 4.19 million acres of National Forest System land within Colorado and conserves roadless area values for future generations, while providing for activities important to the citizens and economy of Colorado. The Rule prohibits tree cutting, road construction and reconstruction, and the use of linear construction zones in roadless areas, with some exceptions. These exceptions address limited state-specific situations. Fewer exceptions apply within the upper tier subset of roadless acres, which provides for a higher level of conservation of roadless area characteristics where the need for additional restrictions, or fewer exceptions, was identified from public input.

The Colorado Roadless Rule supersedes current forest plan direction in the mapped Colorado roadless areas. The Colorado Roadless Rule includes processes to make administrative corrections and boundary modifications, both of which only the Chief of the Forest Service is authorized to approve.

Under the Colorado Roadless Rule, road construction and reconstruction is allowed under certain conditions; however, road construction and reconstruction is not allowed on the majority of the inventoried roadless areas.

Direct, Indirect, and Cumulative Effects

Under alternative A, the majority of the acres of Colorado roadless fall under the backcountry management area prescription (3.3), with the Colorado Roadless Rule sitting as a layer above, but not amended to the forest plan.

Under alternative B, roadless acres become a geographic area reflecting their legal status and related discretion in management. No backcountry management area prescription occurs. Any remaining acres of backcountry management area were added to the adjacent management direction, whether it be deer and elk winter range, grasslands production, or dispersed recreation. The areas are also split between two management area prescriptions, dividing Roadless (3.5) from Upper Tier Roadless (3.6). Some areas currently included in Roadless were found to have wilderness characteristics and are included in Management Area 1.1a – Recommended Wilderness.

Alternative C proposes no change to the existing designated roadless acres, but the area is combined into one with no management distinction between roadless and upper tier roadless, other than direction from the Colorado Roadless Rule.

Alternative D addresses the roadless designation the same as alternative B, with fewer areas considered due to additional designations for special interest areas, research natural areas, and recommended wilderness. Any backcountry areas that remained after the roadless designation are considered the same as in alternative A. Much of the roadless acreage, however, was also found to have wilderness characteristics and therefore is included as recommended wilderness in Management Area 1.1a. Individual descriptions of these areas of recommended wilderness that overlap with roadless areas are contained in Appendix A.

There are no direct or indirect effects on roadless areas among alternatives from implementation of other resource programs, just changes in acreage. Therefore, there would be no cumulative effects to roadless areas.

Proposed Special Interest Areas and Research Natural Areas

Overview

As discussed in Chapter 2, alternative D proposes one new research natural area on Sheep Mountain on the Divide Ranger District and seven additional special interest areas. These areas are:

- Cumbres & Toltec National Historic Landmark Special Interest Area
- Spruce Hole/Osier/Toltec Special Interest Area
- Chama Basin Special Interest Area
- Summer Coon/La Ventana Special Interest Area
- Carnero Creek Special Interest Area
- Jim Creek Special Interest Area
- Deep Creek Special Interest Area.

These additional areas increase the Specially Designated Geographic Area and related management areas in alternative D by approximately 131,000 acres.

Affected Environment, Existing Conditions, and Trends

The areas listed above are proposed in alternative D because they contain features unique to and of special interest in the forest ecosystem. Many designations would enhance habitat connectivity, native fish habitat, and watershed protection. In one case, the designation adds to existing protections for a unique geologic feature and area of tribal importance.

Sheep Mountain Research Natural Area

This area covers about 1,200 acres on the eastern slope of Sheep Mountain on the Divide Ranger District. It is adjacent to the Continental Divide National Scenic Trail Management Area and is within the Pole Mountain/Finger Mesa Upper Tier Colorado Roadless Area. It also includes the Sheep Mountain and San Juan Potential Conservation Areas recommended by the Colorado Natural Heritage Program.

This area provides habitat for the Stonecrop gilia (*Aliciella sedifolia*), a species of conservation concern. Stonecrop gilia is an exceedingly rare plant found in only two locations in the world. The worldwide range of this plant is estimated to be only 1,900 acres. Only about 1,100 individual plants occupy this range. This area also provides habitat for the Rothrock's townsend-daisy (*Townsendia rothrockii*), another species of conservation concern.

Designation of this area as a research natural area would foster increased scientific study of this rare plant and help ensure the viability of this species and its known and potential habitat. In order for such a designation to occur, however, the Forest would need to engage the Research and Development branch of the Forest Service and pursue such a designation with the Chief, in addition to the forest planning process.

Cumbres & Toltec National Historic Landmark Special Interest Area

This area is located on the Conejos Peak Ranger District and borders the Carson National Forest. This special interest area would reflect the recent designation of national historic landmark status for the railroad corridor by the National Park Service. The railroad and the designation are addressed in Assessment 13 (USDA Forest Service 2016). Unique values include natural scenery, historic context to the formation of the Forest, and contributions to the economies of Antonito, Colorado and Chama, New Mexico. The desired condition for this area would favor scenic and recreational values and uses within the designated corridor while continuing to manage the multiple use values of the landscape. Interpretation and opportunities for education are encouraged.

Spruce Hole/Osier/Toltec Special Interest Area

This area is estimated at 36,600 acres and is located on the Conejos Peak Ranger District. It is bounded on the north by the Conejos River as well as Highway 17, which also creates the western boundary. The southern boundary is the Colorado-New Mexico state line where the Rio Grande and the Carson National Forests meet. This area includes three different potential conservation areas recommended by the Colorado Natural Heritage Program, as well as portions of the Sheep Creek Upper Tier Roadless Area.

The special interest area would enhance habitat connectivity for large game species including mule deer, elk, pronghorn, and Rocky Mountain bighorn sheep as well as for large carnivores such as Canada lynx, mountain lions, and black bears. It would also enhance ecosystem integrity related to the viability of several species of conservation concern and federally protected species, including boreal owl, peregrine falcon, Brewer’s sparrow, flammulated owl, Rio Grande cutthroat trout, Gunnison’s prairie dog; Ripley’s milkvetch, slender cliffbrake, Plumber’s cliff fern, Colorado divide whitlow grass, and flowered gilia; federally protected species such as Mexican spotted owl, southwestern willow flycatcher, yellow-billed cuckoo, and New Mexico meadow jumping mouse; migratory birds including ferruginous hawks, black swifts, sage sparrows, burrowing owls, Cassin’s finches, Grace’s warblers, gray vireos, juniper titmouse, Lewis’s woodpeckers, loggerhead shrikes, long-billed curlews, mountain plovers, pinyon jays, and Virginia’s warblers.

Chama Basin Special Interest Area

This approximately 17,790-acre area is proposed for watershed protection. Located on the Conejos Peak Ranger District, the area encompasses the entirety of the headwaters of the Chama River not already included within the South San Juan Wilderness. Acquired by the Forest Service from by the Hughes Family in 1943, this area was previously part of the patented Tierra Amarilla Land Grant.

This area would include the upper boundary of the watershed, including the western and eastern rims of the area where the watershed divides. The northern boundary is the national forest boundary or the wilderness boundary, with the uppermost mile or two of the West Fork and East Fork located within adjacent conserved private land (Banded Peak Ranch) or adjacent designated wilderness (South San Juan). The southern boundary is the national forest boundary. This area includes portions of the existing Chama Basin Colorado Roadless Area and is recommended as the Rio Chama Potential Conservation Area by the Colorado Natural Heritage Program for unique wildlife and botanical values.

National Forest System Road 121 provides access to the southern, lower reaches of the Rio Chama at the Forest boundary. A system of motorized and nonmotorized trails provide access to the area’s interior.

More than 10 miles of streams within the Chama Basin are eligible for inclusion with the National Wild and Scenic Rivers System. These include both the East Fork and West Fork of the Rio Chama, as well as five miles of Archuleta Creek.

This area has previously been evaluated as possessing high potential for oil and gas resources. In 2011, however, the Forest completed acquisition of the mineral rights through a project called the Banded Peak Land Exchange. This project consolidated surface and mineral estates under Federal jurisdiction, thereby assuring compatible management. Federal ownership of the mineral estate allows complete discretion to the Forest Service about future mineral leasing.

This area is currently managed as roadless with one designated motorized trail. Grazing is allowed. The desired condition for the special interest area is to remain natural appearing and nonmotorized except on designated routes. Oil and gas leasing would occur at the discretion of the responsible official, with existing no surface occupancy stipulations.

Summer Coon/La Ventana Special Interest Area

This area covers about 22,400 acres and would include the full extent of the unique geologic features related to the Summer Coon volcanic field. It would expand the existing Elephant Rocks Special Interest Area located north of Del Norte on the Divide Ranger District. The expanded area is defined by La Garita Creek on the north, by the national forest boundary on the east and south, and generally by Old Woman Creek or private land along the west. It also shares a boundary with Penitente Canyon Special Recreation Management Area on the east side, which is managed by the Bureau of Land Management.

This expanded area would include the well-exposed interior of a composite volcano which at one time was comparable to the size of Mount Rainer. This volcano formed in the Southern Rocky Mountain Volcanic Field along the edge of the younger Rio Grande Rift. The expanded area would also incorporate a nearly perfect pattern of radial dikes not currently included in the Elephant Rocks Special Interest Area, as well as the Natural Arch/La Ventana, an opening eroded into the center of one of the most prominent dikes. As mentioned above, the Natural Arch is also an area of tribal importance.

The expanded area would also incorporate the Eagle Mountain and Elephant Rocks Potential Conservation Areas recommended by the Colorado Natural Heritage Program for their high biodiversity significance. These areas include a medium-sized population of the rock-loving neoparrya, a rare milkvetch (*Astragalus cerussatus*), nesting habitat for peregrine falcons, and high quality habitat for bighorn sheep.

The desired condition for this area would be to continue to provide high-quality habitat for the Neoparryi and bighorn sheep. Grazing would continue to be allowed. Motorized and mechanized travel would be suitable on designated routes.

Carnero Creek Special Interest Area

Estimated at 42,800 acres, this area is located on the Saguache Ranger District. It is proposed for its unique concentration of native Rio Grande cutthroat trout. This area is also of interest because several Forest Service and U.S. Geological Survey projects to improve habitat for the species have taken place here. The desired condition would be to continue to provide high quality habitat for Rio Grande cutthroat trout as well as opportunities for partnerships in habitat restoration projects.

Jim Creek Special Interest Area

This area is approximately 9,500 acres and is located on the Conejos Peak Ranger District. Similar to the Carnero Creek area discussed previously, this special interest area is also proposed for its unique concentration of native Rio Grande cutthroat trout and also has a history of Forest Service and U.S. Geological Survey projects to improve habitat for the species. The desired condition would be to continue to provide high quality habitat for Rio Grande cutthroat trout as well as opportunities for partnerships in habitat restoration projects.

Deep Creek Special Interest Area

This approximately 340-acre area is located on the Divide Ranger District south of Creede. This special interest area is proposed for its unique botanical values, which include habitat for two rare plants: Rocky Mountain draba (*Draba graminea*) and Black Canyon gilia (*Aliciella/Gilia penstemonoides*). Both plants are species of conservation concern. This area includes the proposed Deep Creek Uplands West Potential Conservation Area recommended by the Colorado Natural Heritage Program and is in the Snowshoe Mountain Colorado Roadless Area. The desired condition for the area would be to continue to provide high-quality habitat for these rare plant species. Grazing would continue and motorized and mechanized travel would be suitable on designated routes.

Direct and Indirect Effects

The majority of additional acreage tied to the proposed special areas in alternative D is already managed as roadless in alternatives A, B, and C. These areas would be managed in a substantially natural condition, where ecosystems primarily reflect the influence of natural processes. Plant and wildlife habitat values for which the special area was identified would be maintained. Invasive plant species would be controlled. Educational and research opportunities would be provided, featuring the ecological and plant communities associated with the special areas. Suitable vegetation management or other activities near special areas would be evaluated for potential impacts to the plant species, plant communities, and other associated qualities.

The proposal of the Cumbres & Toltec Special Interest Area in alternative D would mirror the existing scenic railway corridor present in Management Area 4.21. Management direction would be updated to incorporate the heritage features of the national historic landmark designation but otherwise, there would be no change among all alternatives.

Effects on Proposed Special Areas from Timber Harvest and Vegetation Management

Special areas are unsuitable for timber production and for commercial removal of special forest products. Vegetation management, including harvest, would occur only for purposes of maintaining the values and qualities associated with the special area.

Effects on Proposed Special Areas from Fire Management

Desired conditions in special areas maintain an ecosystem that primarily reflects the influence of natural processes. These natural processes would include fire in some areas. Most wildfires would require suppression measures for purposes of protecting values both within and outside the special areas. Wildland fire would be implemented in special areas for purposes of maintaining natural processes and desired vegetation conditions.

Effects on Proposed Special Areas from Livestock Grazing

Grazing would be allowed in proposed special areas unless impacts would be contrary to the values for which the area is created. Invasive species control would occur throughout areas as needed using the appropriate control methods. Control of invasive species would have a positive impact on the native plant species and communities.

Effects on Proposed Special Areas from Road Construction, Reconstruction, and Management

Existing roads would be retained in proposed special areas unless prioritized for decommissioning to benefit the values for which the area is created. No new roads are allowed.

Effects on Proposed Special Areas from Developed and Dispersed Recreation

Access and recreational uses would be restricted in special areas, protecting the qualities associated with the areas. Developed recreation would be limited and linked to interpretation of the unique values of the area.

Effects on Proposed Special Areas from Designation of Wilderness and Wild, Scenic, and Recreational Rivers

Special areas would maintain their designated boundaries and would benefit from wilderness and wild, scenic, and recreational river designation.

Effects on Proposed Special Areas from Mineral Resource Activities

While the withdrawal of locatable minerals may be encouraged in management direction for special areas, all designations of special areas on the Forest are subject to valid and existing rights. The existence of such rights and the potential for exploration are factors considered in the recommendation of special areas and the feasibility of maintaining the values for which these areas would be created.

Cumulative Effects

Management activities generally have taken place, and would continue to take place, mostly outside of the existing and proposed special areas. It is unlikely that they would have an effect on special areas because of the distance from the areas and the various plan components that protect soils, water, and other resource values Forestwide. Other programmatic management activities would be heavily restricted in special interest areas and would therefore result in few, if any, cumulative effects.

Areas of Tribal Importance

Overview

The San Luis Valley and the surrounding San Juan and Sangre de Cristo Mountains are the ancestral homelands of several American Indian clans, bands, and tribes. Despite their removal by the Government in the late 1800s, several tribes maintain strong cultural and spiritual connections to the planning area. Many areas represent the groups continuing interest in the homeland-related traditions. Tribes look to the Forest to aid in the maintenance and re-establishment of cultural connections to ancestral landscapes. This section analyzes potential effects to tribal interests, traditional knowledge, tribally affiliated cultural resources, sacred sites, treaty rights, and religious freedom.

Since completion of the forest plan more than 20 years ago, much has changed in terms of policy development and how the Forest Service consults with tribes, programmatically integrating consultative elements into pertinent planning documents, including the recognition and appropriate management of traditional and cultural landscapes. The legal framework of Federal policy, case law, and Executive orders provides guidance and establishes a higher standard for tribal consultation, authority to facilitate reburial of Native American human remains on National Forest System lands, a provision for tribes to collect forest products, and the protection of sensitive information. This legal framework has also created pathways to greater collaboration and connection between the Forest and the tribes, from the district level up.

Affected Environment, Existing Conditions, and Trends

Contemporary tribes with distinct ties to the Rio Grande and the greater San Luis Valley include the Jicarilla Apache, Navajo (Diné), Southern Ute, Ute Mountain Ute, and several Upper Rio Grande and Western Pueblo Tribes. Ceremonial and culturally important landscapes, sites, and traditional gathering areas for certain plants and other materials exist on the Forest. The Forest is also recognized as containing the burials of American Indian ancestors.

From a tribal perspective, the affected environment contains the ancestral homelands of several indigenous groups (Table 86). Continued, mutually satisfying engagement with the Forest and enhanced and meaningful consultation has broadened understanding of the degree to which certain tribes have an interest in the planning unit and the greater San Luis Valley. Generally speaking, tribal interests in the Forest are largely cultural in nature, though importance is also ascribed to intact ecosystems and the relationships of plants and animals to people and places. For many tribal people, features on the Forest still figure powerfully in their traditions and world views. Visiting and reconnecting to these places on the landscape affirms cultural continuity.

Table 86. Tribes affiliated with the plan area

Tribe/Clan/Band	Language
Comanche Tribe	Uto-Aztecan: Numic
The Hopi Tribe	Uto-Aztecan: Hopi
Jicarilla Apache Nation, White Clan/Ollero	Athabaskan
The Navajo Nation (Diné)	Athabaskan: Diné
Pueblo of Acoma	Keres
Pueblo of Cochiti	Keres
Pueblo of Laguna (Kawaik)	Western Keres: Kawaik
Pueblo of Nambe	Kiowa-Tanoan: Tewa
Pueblo of Ohkay Owingeh (San Juan)	Kiowa-Tanoan: Tewa
Pueblo of Picuris	Kiowa-Tanoan: Tiwa
Pueblo of Santa Ana (Tamaya)	Keres
Pueblo of Santa Clara	Kiowa-Tanoan: Tewa
Pueblo of Santo Domingo	Eastern Keres: Kewa
Pueblo of San Ildefonso	Kiowa-Tanoan: Tewa
Pueblo of Taos	Kiowa-Tanoan: Tiwa
Pueblo of Zuni	Zuni (a language isolate)
Northern Ute Indian Bands: Yamparika, Uncompahgre, Uinta, White River	Uto-Aztecan: Numic
Southern Ute Indian Bands: Moache, Capote	Uto-Aztecan: Numic
Ute Mountain Ute Bands: Tabeguache, Weminuche	Uto-Aztecan: Numic

Traditional Cultural Properties

Two known landforms on the Forest have significant cultural importance for several tribes. These include Mt. Blanca on the Conejos Peak Ranger District and the Natural Arch on the Divide Ranger District. For the Navajo Tribe, or Diné, Mt Blanca is known as Sisnaajini or "Black Belt Mountain," with a belt made of white shells. The peak marks the eastern boundary of the Dinetah, or the Navajo homeland, and is considered a living breathing entity. The nearby wetlands and the sand dunes that flank the mountain are revered as critical components of the life force of the mountain. The Jicarilla Apache also call the mountain Nishnojini, also "Black Belt," and it is the location where Monster Slayer, Nío nas ga né, directed Jicarilla and Navajo people from the top of the mountain. It is also thought that the clouds retain the essence of the spirits that bring water. The Kaputa (Capote) Ute consider the mountain a holy place and call it Peeroradarath, "the monster's back," "great grandmother serpent," or "dragon's back," with Blanca Peak as the head and the Sangre de Cristo range to the north, as the body. Near the mountain was an old lake, Aripit, where Ute ancestors hunted the mastodon and the big buffalo, the Hooche. Mt. Blanca is also an important anchor point in the cultural landscape of the Upper Rio Grande pueblos, known as Pintsae'i'i or "White Mountain" in Tewa.

Currently, Mt. Blanca is considered an eligible Traditional Cultural Property by Navajo, Ute, and Jicarilla Apache. At this time, the mountain is managed by four different land management entities, including the Forest: the San Carlos Ranger District of the Pike-San

Isabel National Forest, the San Luis Valley Field Office of the Bureau of Land Management, and the private Trinchera Blanca Ranch that includes a conservation easement covering the south and southeastern portion of the mountain held by the U.S. Fish and Wildlife Service. The Forest manages the upper western flanks of the peak that is designated as wilderness with the exception of a four-wheel drive road that traverses the southwest flank of the peak and ends just short of the basin.

On the west side of the planning area, the Natural Arch is a significant cultural marker on the landscape. Part of a volcanic dike within the Summer Coon complex, this unique geologic feature is located on the northeastern portion of the Divide Ranger District and is a popular destination for the public. Jicarilla Apache call it Hole in Rock, Tséghá' go'áń́n. The Ute call the site Bear's Den, Kweeahghaat - ti Kahn. It is known as a former rendezvous place for Jicarilla Apache clans and Ute bands. Currently, the Natural Arch is considered an eligible Traditional Cultural Property by Ute and Jicarilla Apache. It is important to note that there are other sacred sites on the Forest yet unknown to archaeologists or land managers.

The Utes are documented to have encampments within Conejos River Canyon, on Cochetopa Pass and Saguache Creek. Their ceremonies were conducted in Crestone and Penitente Canyon, and an established Bear Dance site near the present day Old San Acacio in the southern end of the valley has been validated. The Jicarilla Apache also ascribe great significance to the Rio Grande (Cut Soy) and the Rio Grande Pyramid, both within the planning area. Both tribes ascribe importance to rock art sites within the San Luis Valley.

Certain site types have particular meaning to tribes that formally occupied the San Luis Valley. Both Ute and Jicarilla Apache groups peeled Ponderosa pine trees for food and supplies to make implements such as cradle boards and saddle parts. Culturally modified trees still exist in groves and as single trees within the planning area. These trees have increased in appreciation as features of tribal presence in addition to their archaeological value as chronological markers of land use and seasonal migration. The Forest educates its timber and fuels crews in the identification of culturally modified trees and developed a treatment plan for the trees that fall within prescribed burning projects. Likewise wickiups, or conical pole structures, and burial scaffolds in trees are known within the planning area and are also sites of tribal importance, especially to the Utes and Jicarilla Apache. All tribes affiliated with the planning area consider prehistoric archaeological sites as significant ancestral sites, "footprints" of those who came before.

Currently, indigenous people with cultural ties to the San Luis Valley live outside of the planning area. Since their removal in the late 19^{th} century, much in the way of cultural memory and relationship to place has been lost. A doctrine of forced acculturation and loss of language served to further sever ties to ancestral homelands and by extension, a common memory and a comprehensive atlas of culturally, historically, and spiritually important places within the planning area has been lost. However, important threads still exist and serve to maintain rich and substantive ties to the planning area. Just previous to and again during the assessment process, it was learned that the Comanche Tribe maintains a stronger affiliation to the San Luis Valley area than previously known. An important tribal consultation and management trend of recent interest is the renewed interest by tribes to connect tribal members, especially youth, to ancestral homelands. The Forest is poised to be an evolving platform for cultural connection due to its meaningful relationships with tribes affiliated to the San Luis Valley.

Existing Tribal Rights

It is important to note that a series of treaties that were violated by the U.S. Government prior to the current reservation system existed with the Utes within the planning area. These include the Treaty with the Tabeguache (1863), the Treaty with the Utes (1868), and the Brunot Treaty (1874). The Colorado Gold Rush of 1859 brought hundreds of trespasser prospectors and unauthorized mining camps into Ute Territory. For the next 20 years there was constant pressure on the Utes to relinquish their land by the United States, the State of Colorado, and mining and railroad interests. This systematic removal was accomplished by a series of negotiations and treaties entered into with the United States, which were then disavowed by the Federal government. The Tabeguache Treaty was crafted in Conejos, Colorado, ceding one-fourth of Ute Territory, the southern San Luis Valley and other areas in Colorado. It was signed by a leader of the Tabeguache Ute. Leaders of the Moache and Capote Bands refused to sign.

The Treaty of 1868 was signed by a Ute delegation in Washington D.C. This time, one-third of their remaining land base was ceded to the United States. The Utes lost their territory east of the Continental Divide but retained the western slope of Colorado. The treaty guaranteed that the U.S. Government would keep out all non-Indians and no unauthorized person would be allowed to cross the 170th parallel. The Utes demanded the government enforce previous treaties and objected to the people overrunning their land. The U.S. Government was preparing to use the military to expel the squatters from Ute land but the squatters demanded that the Utes be driven out of the mine-rich mountains instead. The Government solution was to again reduce the size of the Ute Reservation. It wasn’t until the Brunot Treaty of 1874 that miners were legitimately allowed to work the land by paying the Ute a tribute of 12 cents per acre on disputed lands. This arrangement lasted only until 1879, when the Ute were expelled from Colorado, except for the Southern Ute Indian Reservation in the southwestern corner of the state. While the Utes lost their last vast tract of land within their Colorado territory, part of the Brunot Treaty would be recognized by the United States and the State of Colorado late in the 20th century.

Hunting Rights: The Brunot Treaty

The Brunot Agreement, ratified by Congress in 1874, withdrew more than 5,000 square miles in the mountains of southwest Colorado from the existing 1868 Ute Reservation. The agreement, entered into between the United States (as represented by Felix Brunot) and the Ute Indians in Colorado, was passed into law (18 Stat. 36) by the House of Representatives and the Senate of the U.S. Congress on April 29, 1974. Under the “reserved rights doctrine,” hunting rights on reservation lands relinquished by the Utes were retained; that is, the tribes retained such rights as part of their status as prior and continuing sovereigns. Article II of the Brunot Agreement specified that “the United States shall permit the Ute Indians to hunt upon said lands so long as the game lasts and the Indians are at peace with the white people.” The Ute Mountain Ute Tribe’s hunting rights were acknowledged when the tribe sued the State of Colorado for their historical hunting rights in 1978. The rights were settled to the tribe under a consent decree that recognized the right of enrolled members of the Ute Mountain Ute Tribe to hunt deer and elk in the Brunot area for subsistence, religious, or ceremonial purposes. The consent decree specified that tribal members may hunt deer and elk without a state license year-round, providing that they obtain a tribal hunting permit. In 2013, the Ute

Mountain Ute Tribe renegotiated this agreement with the State of Colorado to include the tribe's fishing rights and the right to hunt a certain number of black bears, moose, mountain goats, bighorn sheep, and mountain lions, in addition to the existing harvest of elk and mule deer within the Brunot area. Other game animals may be hunted without a license and without harvest limits, but only during hunting seasons established by Colorado Parks and Wildlife. In 2008, the Southern Ute Indian Tribe signed an agreement with the State of Colorado formally acknowledging their hunting and fishing rights within the Brunot area as well.

The Forest will continue to ensure that the hunting and fishing rights of the 1874 Brunot Agreement are upheld on public lands under their management jurisdictions. In exercising their Brunot hunting rights, the Ute Mountain Ute and Southern Ute tribal members adhere to Federal policy and regulations designed to protect natural and cultural resources, and enrolled members of the Ute Tribe can access their treaty area to exercise hunting rights. The Brunot Agreement tract contains parts of the present day counties of San Juan and Hinsdale within the planning area (see the *Brunot Treaty* map, which is contained on the DVD located at the back of this document).

Spiritual Rights

Currently, tribes have access to Natural Arch and Mt. Blanca to practice their religious and spiritual way of life. At times groups have asked the Forest for assistance in short-term road closures to allow for privacy when conducting ceremonies. The Mt. Blanca massif is managed by three Federal land agencies and one private landowner. There exists the potential for conflicting management approaches, and this warrants frequent communication and coordination. A popular four-wheel drive road up the mountain draws a multitude of off-road enthusiasts, resulting in trash, toxic materials, and toxic substances such as oil and antifreeze on the mountain.

The Natural Arch is a popular sightseeing destination as well as a favorite destination for local residents. Unfortunately, trash and graffiti are common problems at the Natural Arch. Because of the high visitation, pressures on the landscape, and large number of people climbing up to the arch opening, soil erosion has become a major issue at the site. The Divide Ranger District has proposed an established trail route to the opening, but the Jicarilla Apache Tribal Historic Preservation Office is opposed to creating easier access for recreation.

Collection Rights

Under the provisions authorized in the Farm Bill, when conducting activities for traditional and cultural purposes, tribal members may collect botanical and other special forest products on National Forest System lands. The Forest also coordinates and collaborates with tribal governments to increase awareness and knowledge of culturally significant plants, and will consider potential impacts on culturally significant plants in project design and implementation. Prescribed burn plans, noxious weed control, and other management projects should address and consider traditional uses and traditional management of culturally significant plants. Of particular note is the ethnobotanical importance of the oshá plant (*Ligusticum porteri*) and its sacredness to several tribes affiliated with the plan area. After harvesting, various forms of the roots are used as medicine. Known to grow in parts of the plan area, the plant is also known as "bear root" by some tribes. The plant is locally abundant but regionally rare, and is considered a sacred plant by several tribes, including the Jicarilla Apache, Ute, Navajo, and several Pueblo tribes. The planning area serves as important refugia for plant populations in the Southwest and should be managed for sustainable personal use by tribal, Hispanic, and other communities. Most tribes are in opposition to any commercial harvest of the plant due to its sacredness and its local abundance but regional rarity.

More than 100 years of fire suppression have resulted in a substantial increase in fuel loading, which could result in large catastrophic wildfires with a high potential to destroy sites that are important to tribes, rather than the low intensity and low severity fires that occur in a more balanced, fire-resilient ecosystem. These sites might include culturally modified trees, wickiups, and burial scaffolds.

More information on special forest products is contained in the *Forest Products and Contributions to Social and Economic Sustainability* sections.

San Luis Valley Intertribal Interagency Memorandum of Understanding

Few things are more important to tribal peoples than the reburial of ancestors whose remains have been removed from their resting place by universities for research, ranchers, or other entities in the past. The protection in place of ancient burial sites and the reburial of remains taken from the planning area are of the utmost importance. The potential for inadvertent discoveries of human remains is high within the planning area.

To be prepared in the face of such potential, the San Luis Valley Intertribal and Interagency Native American Graves Protection and Repatriation Act Memorandum of Understanding was developed. Signatories include the Navajo Nation, the three Colorado Ute Tribes, the Jicarilla Apache Nation, the Pueblo of Zuni, the Ohkay Owingeh (San Juan Pueblo), the San Ildefonso Pueblo, the Pueblo of Santa Ana, the Santa Clara Pueblo, the Pueblo of Laguna, the Cochiti Pueblo, and the Pueblo of Acoma. Federal agency signatories include the Bureau of Land Management, U.S. Forest Service, National Park Service, and U.S. Fish and Wildlife Service. The memorandum of understanding is designed as a guide for the land management agencies and the tribes in the treatment of inadvertent human burial discoveries in and culturally unidentifiable remains previously taken from the San Luis Valley. Through the construction of the document and several successful reburials, enduring government–to-government relationships have been forged laying a solid foundation for meaningful tribal engagement on Forest projects and programs. Additionally, to address directed action for the reburial of remains, a provision within the 2008 Farm Bill authorizes the reburial of American Indian remains on National Forest System lands.

Direct and Indirect Effects

Areas of tribal importance and interests were identified and defined by tribes through consultation with the Forest Service on plan components for alternative B. Consultation provides the opportunity for tribes to identify potential effects to tribal interests, tribal affiliated cultural resources, sacred sites, treaty rights, and religious freedom. The Navajo Nation has chosen to be a cooperating agency in this plan revision process.

Ground disturbance is a key consideration of effects, as it can negatively impact sacred sites and collection areas. However, consultation is mandatory and implemented under alternative A. The impacts can be further exacerbated by interactions with fire, weather events, human actions, and environmental change. Access to sacred areas to exercise ceremonies and freedoms is another critical consideration for effects. Management actions that change access could either beneficially or negatively impact the exercise of treaty rights and expression of religious freedom.

The action alternatives represent programmatic decisions; therefore, they would have no direct effects on areas of Tribal importance and interests.

Under the no-action alternative, plan direction requires coordination with American Indian tribes on rights and concerns. While the alternative does mention the significance of Mt. Blanca, it is largely silent on areas of tribal importance. The natural arch is not identified as an eligible traditional cultural property or sacred site. Direction is also weak in the areas of tribal consultation and lacking in the legal framework that has developed over the last two decades. Indirect effects could include on-going vandalism to both Mt. Blanca and the Natural Arch without more robust management approaches. However, effects to tribal interests, tribally affiliated cultural resources, sacred sites, treaty rights, and religious freedom are identified and defined by tribes, through consultation.

Under this alternative, however, the Forest would continue to meet its basic obligations to tribes via consultation requirements. Ground disturbance may occur in conjunction with recreation use and facilities and American Indian sites may be encountered in areas with these activities. However, consultation requirements are required and implemented under the no-action alternative to protect and mitigate impacts to American Indian sites if encountered.

Alternative B proposes to recommend the southern flank of Mt. Blanca as wilderness to provide the mountain with more protections as a sacred site. It also proposes to modify the boundary of the current Elephant Rocks Special Interest Area to formally include the Natural Arch for its cultural values along with the botanical values for which it was originally designated. These administrative changes would be expected to decrease the potential for adverse effects to areas of tribal importance. Under alternatives B and D, the southern flank of Mt. Blanca would be proposed as wilderness to best meet tribal objectives of keeping the mountain as 'pristine' as possible (see Assessment 13) (USDA Forest Service 2016). Discussions during several consultation meetings also suggested proposing a special interest area for the same area; however, a wilderness designation would go further in meeting the highest protection possible. Alternatives A and C do not provide for this level of protection and therefore the potential to negatively affect areas of tribal of importance in these alternatives is higher than in alternatives B and D.

Under alternatives B, C, and D, the boundary of the Elephant Rocks Special Interest Area would be adjusted to include the Natural Arch, a newly identified eligible traditional cultural property. Alternative A does not provide for this level of protection, and therefore the potential to negatively affect areas of tribal of importance is higher than in alternatives B, C, and D.

Under alternative C, areas of tribal importance, especially those unknown or inadvertently discovered, may have more potential for adverse effects due to the higher volume of activities proposed in this alternative, especially in the realms of timber salvage and recreational development. However, the positive indirect effects to the oshá plant under increased timber management that include oshá in the understory would be the plant's growth and spread through the opening of the overstory. Additionally, more prescribed burning could have a positive indirect effect on areas of tribal importance by reducing the fuel loading around fire sensitive sites such as culturally modified trees.

Conversely, the potential for adverse effects to areas of tribal importance, especially those unknown or inadvertently discovered, would be expected to decrease under alternative D given its emphasis on increased conservation and fewer administrative activities.

Effects to Areas of Tribal Importance from Management of Other Resources

The effects to tribal interests as a result of all action alternatives are determined and defined by tribes and disclosed by the tribes during consultation. To estimate effects prior to consultation, the action alternatives are contrasted to the no-action alternative to see if they increase, decrease, or result in no change to the potential for adverse effects to areas of tribal importance.

The difference between the action alternatives and the no-action alternative, as currently implemented, is the addition of specific objectives and management approaches to protect known sacred sites and eligible traditional properties and their viewsheds. The need to monitor and protect the culturally significant plant, oshá, is also identified in the action alternatives. Action alternatives call for the evaluation of Mt. Blanca as a traditional cultural property and the subsequent development of a management plan. The action alternatives also use more detailed language to articulate protections already afforded to the tribes under the no-action alternative.

The action alternatives propose additional administrative activities, substantive objectives, and management approaches in the interest of protecting tribal interests on Forest lands. It is anticipated that administrative activities that focus on improving communications and planning activities between the tribes and the Forest would result in a decrease to the potential for adverse effects to areas of tribal importance.

Management actions conducted at the site-specific level that result in ground disturbance have the potential for effects to areas of tribal importance. Because these effects are identified, detailed, and disclosed by tribes during consultation, the Forest and the tribes have the opportunity to work together to determine appropriate mitigation, avoidance, and protection measures. Therefore the consequences to areas of tribal importance from actions associated with these activities are estimated to be minimal and avoidable through consultation under all alternatives.

Cumulative Effects

The effects that past activities have had on areas of tribal importance are discussed previously in the *Affected Environment* section and are reflected in the current condition. Therefore, past activities are not carried over into the cumulative effects analysis.

Some areas of tribal importance such as culturally affiliated resources, and landforms such as the Natural Arch, are by their nature non-renewable resources. Cumulative effects that are the result of unsanctioned activities, such as vandalism or illegal excavation, can occur. Other resources of tribal importance, such as the oshá plant, are a renewable resource if monitored and collected sustainably.

Alternatives that result in more acres of management activities will result in increased acres of inventory. The additional required inventory and evaluation could result in more possible culturally affiliated cultural resources being documented and protected from adverse cumulative effects.

Continuing tribal consultation, the use of the San Luis Valley Native American Graves Protection and Repatriation Act Memorandum of Understanding, and the maintenance of strong working relationships between the Forest and the tribes would minimize the likelihood of adverse cumulative effects to areas of tribal importance under each of the action alternatives.

Lands and Special Uses

Overview

This section addresses landownership administration and adjustments and special uses of National Forest System lands on the Forest. Management of National Forest System lands includes survey and marking of boundaries, acquisition, conveyance and exchange of land, handling of title claims and encroachments, acquisition of rights-of-way, and authorization and management of special uses to protect resource values and the interests of the Federal Government.

Adjustments of landownership can occur through congressionally mandated conveyances, exchanges, and acquisitions, or through Forest Service administrative activities.

The objectives of the Forest Service landownership program are to:

- Achieve the optimum landownership pattern to provide for the protection and management of resource uses to meet the needs of the Nation now and in the future,
- Avoid land-use conflicts with non-federal landowners by settling land claims equitably and promptly, and
- Provide resource administrators readily accessible and understandable title information affecting the status and use of lands and resources they administer.

Land occupancy and uses by private parties and other government entities are managed through the issuance of special use authorizations. Authorized special uses on the Forest include industrial or commercial uses, private uses, and a variety of recreational uses.

All occupancy, use, or improvements on National Forest System lands that are not directly related to timber harvest, grazing, mining activities, and recreation are referred to as ‘non-recreation 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 National Forest System lands by commercial ventures.

Affected Environment, Existing Conditions, and Trends

There are approximately 1.83 million acres of National Forest System lands that are the administrative responsibility of Forest. This is the result of the original congressionally designated lands and the conveyances (acquisitions, disposals, and exchanges) that have occurred to date.

Lands

The 1996 forest plan states that the Forest consists of about 1,852,000 acres. The reduction in acreage suggests that over the life of the 1996 forest plan, more National Forest System lands were disposed of than were acquired. This can largely be explained by the transfer of about 41,000 acres to the National Park Service per the Great Sand Dunes National Park and Preserve Act of 2000. This was offset by the acquisition of the 13,000-acre Baca Mountain tract, by far the largest acquisition over the life of the 1996 forest plan.

An estimated 99,500 acres of lands of other ownership are inside the proclaimed boundaries of the Forest. The vast majority of this land is held in private ownership, and the remainder is owned by the State of Colorado. Much of the private land inside the proclaimed boundaries of the Forest is the result of homestead and mining patents.

Rights-of-way and easements affect both private and public lands throughout the plan area. The Forest continues to seek rights-of-way to safeguard public access to National Forest System lands. And the Forest would continue to grant rights-of-way for access across National Forest System lands in accordance with applicable laws.

Special Uses

All occupancy, use, and improvements on National Forest System lands that are not directly related to timber harvest, grazing, or mining activities are referred to as special uses. Special use authorizations (permits, leases or easements) are legal instruments whose terms and conditions are fully enforceable when consistent with laws regulations and policies. The mission of the Forest Service special use program is to manage the use and occupancy of National Forest System lands in a manner that protects natural resource values, promotes public health and safety, and is consistent with the forest plan.

The Forest administers about 350 special use authorizations, of which 125 are categorized as recreation special uses and 225 are considered land special uses. Recreation uses include recreation events, outfitters and guides, recreation residences, and ski areas. Land uses include research, weather stations, commercial filming, driveways, telecommunications, and water gauging, storage, and transmission.

The Forest regularly receives proposals for the use and occupancy of National Forest System lands. Census data for the counties containing National Forest System lands administered by the Forest have remained relatively stable. Meanwhile, significant population growth along Colorado’s Front Range would suggest that change is coming, and it is expected that the Forest will see an increase in proposals for special uses rather than a decrease. Increased development will present opportunities and challenges for the Forest and its neighbors.

The Forest will need to continue to work with neighboring landowners in response to requests to use National Forest System lands for essential infrastructure to support the growth and sustainability of the communities that surround the Forest. This infrastructure might include roads, utilities, communication facilities, water infrastructure for municipal and agricultural use, and fire stations. Requests for access, goods, and services are expected to increase over the life of the plan. Increased population density on private lands adjoining the Forest will add to the potential for encroachment, trespass, and unauthorized occupancy of National Forest System lands. Balancing the needs for goods and service while protecting the interests of the public will be a challenge into the future depending on the capability of the unit. Occupancy and use of National Forest System lands for public and private purposes through the issuance of special use authorizations will continue to be allowed where the use is consistent with natural resource management goals.

Direct and Indirect Effects

Alternative A – No Action

This alternative reflects the forest plan, as amended to date, and accounts for current laws and regulations, excluding the 2012 Planning Rule, that have been issued since the original forest plan and the amendments that were adopted. There would be no indirect effects to the land program, and changes to ownership boundaries would continue to be analyzed at the project level. The special use program would operate much as it has barring the issuance of new laws and regulations.

Alternatives B, C, and D

Land adjustments and special uses of National Forest System lands can be proposed anywhere in the Forest. Such proposals need to be consistent with the Forest's land and resource management plan and suitable for the management area in which they are proposed. For the purposes of this analysis, a comparison was made among alternatives that focused on the relative changes to management area acreage. An increase in management areas with more limiting direction would be expected to decrease opportunities for conveyance or special uses of National Forest System lands. For example, an increase in recommended wilderness acreage could result in fewer acres available for certain types of special uses, and the Forest would be less likely to dispose of or exchange land that was designated as recommended wilderness. However, an increase in recommended wilderness acres could serve to increase the Forest's interest in acquisition of private inholdings in newly designated acres and certain types of special uses, e.g., outfitters and guides could benefit from an increase in wilderness.

Using the reasoning above, the Forest compared the indirect effects among alternatives by comparing the change in acreage among categories of management that essentially reflect the geographic areas proposed in alternatives B and D: primitive wilderness, roadless, specially designated areas, and general forest. From a lands and special uses perspective, management becomes less restrictive and less limiting down this list, with primitive wilderness being the most restrictive and general forest being the least restrictive. As mentioned above, an alternative with substantially more primitive wilderness or roadless or specially designated areas was considered to have the indirect effect of being more restrictive to land conveyances and the majority of special uses.

The most significant change among alternatives is the introduction of recommended wilderness in alternatives B and D, essentially increasing the acreage of the primitive wilderness category, predominantly at the cost of the roadless category. Alternative D proposes more than five times as many acres as alternative B. Therefore, alternative D would be the most restrictive alternative relative to lands and special uses.

With the additional wilderness acreage largely coming from the roadless category, there is little difference among alternatives relative to the roadless category. Alternative D proposes the fewest acres of roadless category because of the relatively high number of acres that are proposed for the primitive wilderness category. Therefore, this alternative would change the types of special use opportunities permitted.

Concerning the specially designated areas, there is no difference in the number of acres proposed between Alternatives B and C. However, alternative D proposed to nearly double the number of acres. Again, this suggests that alternative D is the most restrictive. However, the specially designated areas category is the least restrictive category after general forest and varies significantly across subcategory. For example, an outfitter and guide use may be restricted in a research natural area, but possibly enhanced by a wild, scenic, and recreational river designation or congressionally designated trail.

In summary, there is not a significant difference between alternatives B and C relative to the lands and special use programs. Alternative B could be considered to be slightly more restrictive due to the acres of recommended wilderness and have fewer opportunities for conveyance of land and fewer types of special uses viewed as suitable as a result. Alternative D appears significantly more restrictive than the other alternatives due to the greater number of acres of recommended wilderness as well as the greater number of acres in a specially designated area. As mentioned earlier, while an increase in acres of these more restrictive management strategies is assumed to result in fewer opportunities, there is also the effect of increasing the interest in acquisition of private parcels by the United States and the possible benefit to a subset of special uses, in particular recreation special uses.

Effects on Lands and Special Uses from Management of Other Resources

Effects from management of other resources were considered but determined to have little or no effect. For example, vegetation management could impact the value of National Forest System lands, but the value may decrease or increase depending on the type of treatment. The same could be said of fire management. In an attempt to secure habitat or linkage areas wildlife management issues might be better served by disposing of certain lands, but acquiring certain other lands. Recreation management was considered as well, and no effects were discovered.

Cumulative Effects

The geographic scope for this analysis is all lands inside the boundary of the Forest. The temporal scope for this analysis is the life of the current forest plan and reasonably foreseeable actions.

As described previously in the *Affected Environment* section, the Forest currently administers approximately 1.83 million acres of National Forest System land. Adjustments in landownership would continue to occur over time. In particular, within its fiscal capabilities, the Forest would continue to pursue acquisition of private inholdings considered to have high resource values, or that through acquisition would decrease administrative costs such as boundary survey costs. In this regard, the number of acres administered by the Forest would be expected to increase. In addition, ongoing boundary marking would continue, and encroachments may be discovered.

Requests for special use authorizations would likely increase because as more private land is subdivided, particularly inholdings, the number of requests for special uses such as roads and utilities, including innovative renewable energy uses such as solar and wind energy, increases. Requests for modification of existing communications sites and designation of new communications sites can reasonably be expected as technology advances and the desire for service increases. Recreation special use proposals are expected to increase both in number and diversity.

Because the number of acres remains the same for the Forest across all alternatives and because changes in landownership boundaries, rights-of-way, and special use authorization are made at the project level, the differences in cumulative effects among alternatives is minimal.

Contributions to Social and Economic Sustainability

Overview

Many communities have longstanding social and economic ties to the natural and cultural resources the Forest provides. This chapter examines the values to people and communities surrounding the Forest and also to people who are further removed from the plan area. In addition to providing an overview of the existing social and economic environments, this section emphasizes plan area’s contributions to socioeconomic sustainability (FSH 1909.12, ch. 20, sec. 23.22). Since management of the plan area contributes to social and economic sustainability in the area(s) of influence and the broader landscape primarily through the provision of (1) multiple uses, (2) ecosystem services, (3) infrastructure, and (4) Forest Service presence in the community (FSH 1909.12, ch. 20, sec. 23.21 and FSH 1909.12, ch.10, sec. 13), the conditions and trends of these major contributions are described in the following sections.

Area of Influence

The information describing local economic and social environmental conditions is obtained, in part, from Assessment 6 – Social, Cultural, and Economic Conditions (USDA Forest Service 2016). Where relevant, updated data are provided. For comparison, Colorado, New Mexico, and the United States are also included.

Eighteen counties made up the social and economic area of influence (Assessment 6). For this report, the social and economic area of influence was updated based on a variety of indicators, including timber, grazing, recreation, payment in lieu of taxes/secure rural schools (PILT/SRS) data, and local knowledge. Counties are included in the social and economic area of influence if supported under one or more of these criteria. For instance, under the timber criteria, counties are included based on the flow of timber sales, processors, and location of timber-related employment; under the range criteria, counties are included based on the location (home or business) of permittees and the amount of animal unit months authorized; and counties are included under the recreation criteria in order to capture the economic contribution of visitor spending, according to the *50 percent recreation market area* as defined by the National Visitor Use Monitoring program for the Forest.

The 16-county area considered in this analysis includes Alamosa, Archuleta, Conejos, Costilla, Custer, Fremont, Gunnison, Hinsdale, La Plata, Mineral, Montrose, Rio Grande, Saguache, and San Juan Counties in Colorado, and Rio Arriba and Taos Counties in New Mexico. Counties that were in the original assessment that have been dropped include Chaffee, Huerfano, and Park. Custer County was not included in Assessment 6 but is in the new social and economic area of influence.

A secondary zone of influence—the San Luis Valley area of influence—is also identified in order to present a more targeted portrayal of the communities intimately connected to the Forest. The inclusion of the San Luis Valley area of influence addresses many comments received from the public concerned that the larger primary area of influence would distort some of the economic and cultural connections of the smaller communities with historic, subsistence relationships with the Forest. This area of influence is based on counties within the San Luis Valley Planning Region as delineated by the State of Colorado Demography Office (Colorado Department of Local Affairs 2017a), which comprised of a total of six counties – Alamosa, Conejos, Costilla, Mineral, Rio Grande, and Saguache. These are the same counties within Region 8 of the Colorado Association of Regional Organizations, as well as the San Luis Valley Development Resources Group – which promotes economic and community self-development for the San Luis Valley. Hinsdale County is also included as part of the San Luis Valley area of influence for the purpose of this analysis, due to the close ties and interests the county has with the management of Forest. In sum, the San Luis Valley area of influence contains seven counties: Alamosa, Conejos, Costilla, Hinsdale, Mineral, Rio Grande, and Saguache Counties.

Affected Environment, Existing Conditions, and Trends

This section describes the conditions and trends of the social and economic environments, with special emphasis on the factors of socioeconomic sustainability, including the four major areas of contributions: (1) multiple uses, (2) ecosystem services, (3) infrastructure, and (4) Forest Service presence in the community.

Social Environment

Population

Population growth can be an indicator of a region's desirability to live and work. Areas characterized as having high levels of natural amenities (unique land and water features, mild temperatures, scenic quality, and outdoor recreation opportunities) experience greater population growth than areas with fewer natural amenities (see Assessment 6), and this growth occurs increasingly at the boundaries of public lands. In recent years communities surrounding the Forest have become increasingly attractive to new residents because of their proximity to open spaces, natural settings, and easy access to year-round recreational opportunities. A portion of population growth in this region can be attributed to the scenic beauty and outdoor recreation supported by the Forest.

Rapid population growth in Colorado and the social and economic area of influence over the last 30 years suggests that this area is highly desirable to current and prospective residents. While the total U.S. population grew by 55 percent between 1970 and 2013, Colorado's population increased by 137 percent, and total population within the social and economic area of influence increased by 94 percent (U.S. Census Bureau 1970, 2013).

During the time period of 2011–2015, the social and economic area of influence was home to 294,121 people and experienced 9 percent growth between 2000 and the 2011–2015 time period, which is well below Colorado's growth rate (23 percent), and only slightly below the growth rate of New Mexico (15 percent) and the United States (13 percent) (U.S. Census Bureau, 2016) (Table 87).

During the time period of 2011–2015, the San Luis Valley area of influence was home to 47,681 people and experienced 2 percent growth from 2000 to the 2011–2015 time period. Conejos, Costilla, and Mineral Counties experienced population loss over this period. At 11 percent, Hinsdale had the highest growth rate in the San Luis Valley area of influence.

Table 87. Population change

[Source: U.S. Census Bureau (2016)]

	Population 2000	Population ACS 5 year (2011–2015)	Percent Change 2000–2015
Colorado	4,301,261	5,278,906	23
Alamosa	14,966	16,269	9
Archuleta	9,898	12,174	23
Conejos	8,400	8,249	-2
Costilla	3,663	3,581	-2
Custer	3,503	4,303	23
Fremont	46,145	46,809	1
Gunnison	13,956	15,651	12
Hinsdale	790	874	11
La Plata	43,941	53,182	21
Mineral	831	733	-12
Montrose	33,432	40,815	22
Rio Grande	12,413	11,745	-5
Saguache	5,917	6,238	5
San Juan	558	606	9
New Mexico	1,819,046	2,084,117	15
Rio Arriba	41,190	39,949	-3
Taos	29,979	32,943	10
San Luis Valley area of influence	46,980	47,689	2
Social and Economic area of influence	269,582	294,121	9
United States	281,421,906	316,515,021	13

Age

The age of the population surrounding the Forest is relevant since age may affect community values and uses of the Forest. In general the population of the United States is growing older, and a sizable share of Americans over 65 years had been moving to amenity-rich places that are characterized as having warmer average temperatures and lower rates of crime and taxes (see Assessment 6). Colorado and New Mexico have both gained attention in recent years as retirement destinations. As a desirable retirement destination, the Forest has attracted a share of migrating retirees and retirement income to the social and economic area of influence.

During the time period of 2011–2015, the median age was 45 in the social and economic area of influence, and 46 for the San Luis Valley area of influence. Additionally for that same time period, 38 percent of the San Luis Valley area of influence population was over the age 50, whereas only 32 percent of Colorado's population was over the age of 50 (U.S. Census Bureau 2016) (Table 88). Therefore, a substantial portion of the population of the San Luis

Valley area of influence will approach retirement age in the near future, which will have affect social and economic conditions.

For more detail on population trends see Assessment 6 – Social, Cultural and Economic Conditions (USDA Forest Service 2016).

Table 88. Median age

[Source: U.S. Census Bureau (2016)]

	Median Age ACS 5 year (2011–2015)
Colorado	36.3
Alamosa	30.1
Archuleta	49.6
Conejos	38.4
Costilla	49.0
Custer	56.4
Fremont	43.5
Gunnison	34.3
Hinsdale	55.2
La Plata	38.8
Mineral	60.9
Montrose	44.2
Rio Grande	40.9
Saguache	46.1
San Juan	46.0
New Mexico	37.0
Rio Arriba	40.1
Taos	46.8
San Luis Valley area of influence	45.8
Social and Economic area of influence	45.0
United States	37.6

Population Density

Population density provides perspective on urbanization, availability of open space, socioeconomic diversity, and civic infrastructure. In general, more densely populated areas tend to be more urban and diverse, and offer more access to public infrastructure. In contrast, less densely populated areas provide greater access to open spaces and wildlands, which may offer natural amenity values to residents and visitors.

Population projections indicate that the San Luis Valley and the region surrounding the Forest will continue to grow through 2030. These population projections reflect continued urban, suburban, and exurban development, enabling counties surrounding the Forest to become more densely populated. Growth within these counties is unlikely to be distributed evenly among local communities and can cause some areas to become more urban while others become increasingly more decentralized or exurban. Overall, however, the region remains rural, with an average population density of 5.6 persons per square mile in the San Luis Valley counties, versus an average of 48.5 persons per square mile for the State of Colorado.

As populations grow, conflicts between local residents and forest visitors may increase. While living close to public lands may provide residents with amenities such as convenient access to recreation and wildlife viewing, increased forest congestion causes disamenities such as crowds, litter, and noise. Increased population of residential areas surrounding the Forest also increases the social and economic area of influence's need for infrastructure and may place greater pressure on the Forest to provide utility right-of-ways. These pressures may threaten the Forest's role in contributing to sense of place and the quality of life in surrounding communities.

For more details on population density, see Assessment 6 (USDA Forest Service 2016).

Education

The level of formal education can be an important indicator of social and economic opportunities and the ability of an area to adapt to change. Educational attainment in Colorado is higher than that of the U.S. population for the time period of 2011–2015: 91 percent hold a high school diploma and 38 percent have a Bachelor's degree or higher, while 87 percent of U.S. residents 25 or older have completed high school and 30 percent have obtained at least an undergraduate degree (U.S. Census Bureau 2016) (Table 89). Educational attainment in the social and economic area of influence for the same time period is nearly identical to the U.S. population overall, however, attainment is quite low in some rural counties where less than 80 percent of residents over the age of 25 have high school diplomas and a small percentage hold a Bachelor's degree or higher. Low educational attainment in rural areas is not uncommon. Since rural communities generally offer few opportunities for educational or occupational advancement, they typically struggle to retain and attract educated and highly skilled individuals. Residents interested in pursuing advanced education typically move from these rural communities to more economically advanced areas that support greater educational opportunities. The out-migration of talented and educated residents is often referred to as "brain drain."

Table 89. Education attainment, adults 25 and over, ACS 5 year (2011–2015)

[Source: U.S. Census Bureau (2016)]

	High School Graduate (percent)	Bachelor's Degree or higher (percent)
Colorado	91	38
Alamosa	85	25
Archuleta	92	35
Conejos	85	19
Costilla	76	18
Custer	94	35
Fremont	87	15
Gunnison	95	54
Hinsdale	95	40
La Plata	95	43
Mineral	98	42
Montrose	87	24
Rio Grande	83	22
Saguache	79	27
San Juan	92	29
New Mexico	84	26
Rio Arriba	81	17
Taos	87	29
San Luis Valley area of influence	86	28
Social and Economic area of influence	88	28
United States	87	30

Race and Ethnicity

Colorado's population tends to be less racially diverse than the general U.S. population. During the time period of 2011–2015, about 74 percent of the country's population identified themselves as White alone, whereas the category White alone accounts for 84 percent of the state's population. However, in the social and economic area of influence, the percentage of residents identifying themselves as American Indian alone (Native Americans) and those identifying as some other race alone is larger than Colorado and the Nation (Table 90). There is considerable variation in the racial composition of individual social and economic area of influence counties during this time period (2011–2015). For example, La Plata, Rio Arriba, and Taos Counties contained greater percentages than Colorado and the Nation of individuals identifying as American Indian alone.

Table 90. Racial composition ACS 5 year (2011–2015)

[Source: U.S. Census Bureau (2016)]

	White Alone	African American	American Indian	Asian Alone	Other Race Alone	Two or More Races
Colorado	84.2%	4.0%	0.9%	2.9%	4.3%	3.5%
Alamosa	87.0%	1.9%	2.0%	1.8%	4.6%	2.6%
Archuleta	87.4%	0.9%	2.3%	0.7%	7.5%	1.1%
Conejos	91.7%	0.1%	1.9%	0.2%	4.3%	1.7%
Costilla	93.0%	0.0%	0.3%	0.8%	2.1%	3.8%
Custer	94.0%	3.1%	1.3%	0.0%	0.2%	1.3%
Fremont	88.0%	5.2%	1.6%	0.7%	2.1%	2.3%
Gunnison	95.7%	0.7%	0.5%	0.6%	0.4%	2.0%
Hinsdale	98.4%	0.0%	0.0%	0.0%	0.0%	1.6%
La Plata	88.6%	0.4%	5.5%	0.7%	2.4%	2.3%
Mineral	89.9%	0.8%	0.0%	0.0%	8.7%	0.5%
Montrose	92.6%	0.6%	0.7%	0.4%	3.2%	2.1%
Rio Grande	84.5%	0.8%	2.1%	0.4%	10.7%	1.4%
Saguache	87.7%	0.4%	1.3%	1.1%	6.6%	3.0%
San Juan	94.2%	0.0%	1.5%	0.0%	3.5%	0.8%
New Mexico	73.2%	2.1%	9.1%	1.4%	10.9%	3.3%
Rio Arriba	62.5%	0.5%	15.3%	0.4%	19.0%	2.3%
Taos	70.6%	0.5%	6.1%	0.8%	18.4%	3.6%
San Luis Valley area of influence	90.3%	0.6%	1.1%	0.6%	5.3%	2.1%
Social and Economic area of influence	87.8%	1.0%	2.6%	0.5%	5.9%	2.0%
United States	73.6%	12.6%	0.8%	5.1%	4.7%	3.0%

Many Americans identify with, and are proud of, the ethnic and cultural heritage from which they descend. Although Americans may appear to look White, Black, Asian, or belonging to some other racial group, they typically continue to speak the native language and follow cultural traditions from the regions where their families originated. During the time period of 2011–2015, 17 percent of Americans and 21 percent of Colorado residents described their family ancestry as being Hispanic, Latin, or Spanish. Hispanic cultures are more predominant in the social and economic area of influence than in Colorado overall, 30 percent versus 21 percent. The San Luis Valley area of influence had an even larger population of Hispanic residents (37 percent). Hinsdale is the only county in the San Luis Valley that did not have a large population of Hispanic residents and is nearly 99 percent non-Hispanic (Table 91) (U.S. Census Bureau 2016).

Table 91. Ethnic composition, ACS 5 year (2011–2015)

[Source: U.S. Census Bureau (2016)]

	Hispanic	Non-Hispanic
Colorado	21.1%	78.9%
Alamosa	45.7%	54.3%
Archuleta	18.5%	81.5%
Conejos	54.4%	45.6%
Costilla	64.4%	35.6%
Custer	2.7%	97.3%
Fremont	13.0%	87.0%
Gunnison	9.0%	91.0%
Hinsdale	1.3%	98.7%
La Plata	12.5%	87.5%
Mineral	10.8%	89.2%
Montrose	20.2%	79.8%
Rio Grande	44.2%	55.8%
Saguache	38.9%	61.1%
San Juan	19.3%	80.7%
New Mexico	47.4%	52.6%
Rio Arriba	71.5%	28.5%
Taos	56.2%	43.8%
San Luis Valley area of influence	37.1%	62.9%
Social and Economic area of influence	30.1%	69.9%
United States	17.1%	82.9%

Environmental Justice

Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, states that “each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations.” More detailed information including pertinent definitions are discussed in Assessments 6, 9, and 13 (USDA Forest Service 2016). In summary, social and economic data describing the demographics and economic conditions of communities surrounding the Forest indicate that there are concentrations of minority populations and low-income populations within the social and economic area of influence. Many communities have maintained strong ties to subsistence uses and ancestral lands they rely on for a variety of traditional, cultural, subsistence, forest product, fishing, and hunting uses. Communities in the area can be defined in Council of Environmental Quality terms as meeting classification for determination as environmental justice populations (low income and minority). In the planning area, a number of communities have advocacy groups working on environmental justice issues that have engaged in this revision process. Their focus has included air quality, and access to the Forest for traditional uses, among others.

Economic Environment

Unemployment

Historically, unemployment in the social and economic area of influence has closely mirrored that of the State of Colorado and generally remains higher than statewide trends. The economic downturn in 2007 caused unemployment across the United States to rise, hitting Colorado and the region surrounding the Forest relatively hard. Low unemployment rates in the United States and Colorado in 2016 indicate that the effects of the Great Recession (the time period from 2007 to 2009) on unemployment have largely been recovered.

The unemployment rate in 2016 for the social and economic area of influence averaged 4.3 percent. Colorado counties in the social and economic area of influence had an average unemployment rate of 3.7 percent, which was slightly higher than Colorado’s average (3.3 percent) and below the U.S. average (4.9 percent). New Mexico counties (Rio Arriba and Taos) experienced the highest unemployment rates in the social and economic area of influence, averaging 7.7 percent in 2016, which are above both New Mexico’s (6.7 percent) and the U.S. average rate. Detailed unemployment statistics are listed in Table 92.

Table 92. Unemployment, annual average

[Source: U.S. Bureau of Labor Statistics (2016)]

	2015	2016
Colorado	3.8	3.3
Alamosa	5.2	4.1
Archuleta	4.0	3.4
Conejos	5.6	4.8
Costilla	6.5	5.0
Custer	3.5	3.1
Fremont	6.2	5.2
Gunnison	2.9	2.3
Hinsdale	3.0	2.4
La Plata	3.5	3.0
Mineral	3.7	2.3
Montrose	5.1	4.2
Rio Grande	6.3	5.1
Saguache	6.1	4.8
San Juan	4.1	3.8
Colorado County Average	4.7	3.8
New Mexico	6.5	6.7
Rio Arriba	8.0	7.2
Taos	9.3	8.2
New Mexico County Avg.	8.7	7.7
San Luis Valley area of influence	5.2	4.1
Social and Economic area of influence	5.2	4.3
United States	5.3	4.9

Personal Incomes

Although the average unemployment rate for the social and economic area of influence is below the national average, during the time period of 2011–2015, median and per capita incomes were well below Colorado and national averages. Median and per capita income data provide a measure of all sources of income (wages, investment income, retirement, etc.) within the social and economic area of influence. High personal income may be a signal of greater job opportunities, highly skilled residents, greater economic resiliency, and well-developed infrastructure within a community, while low personal income is typically a reflection of poor economic conditions and the relatively few economic opportunities available within a community.

During the time period of 2011–2015, the median household income in the social and economic area of influence averaged $41,694, nearly $20,000 dollars less than Colorado’s average ($60,629), and $12,000 less than the national average ($53,889) (U.S. Census Bureau 2016).

During this same time period (2011–2015), the San Luis Valley area of influence's average median income was $39,806, and average per capita income was $24,321, well below both state and national averages. Mineral and Hinsdale are the only two counties in the San Luis Valley area of influence that had incomes at or near state and national averages, ($48,125 and $57,803, respectively). Costilla, Alamosa, and Saguache have the three lowest median incomes in the entire social and economic area of influence, ($31,121, $32,395, and $33,393, respectively). A list of incomes by county is provided in Table 93.

Table 93. Median household and per capita income, ACS 5 year (2011–2015)

[Source: U.S. Census Bureau (2016)]

	Median Household Income	Per Capita Income
Colorado	$60,629	$32,217
Alamosa	$32,395	$19,524
Archuleta	$46,646	$28,884
Conejos	$36,652	$18,844
Costilla	$31,321	$21,809
Custer	$35,000	$22,661
Fremont	$40,423	$18,619
Gunnison	$48,071	$25,584
Hinsdale	$57,083	$33,816
La Plata	$60,278	$31,822
Mineral	$48,125	$32,271
Montrose	$43,999	$23,144
Rio Grande	$39,672	$22,269
Saguache	$33,393	$21,711
San Juan	$36,324	$23,143
New Mexico	$44,963	$24,012
Rio Arriba	$36,098	$19,678
Taos	$36,582	$22,358
San Luis Valley area of influence	$39,806	$24,321
Social and Economic area of influence	$41,694	$24,486
United States	$53,889	$28,930

Poverty

The poverty rate is another indication of both economic and social well-being. Individuals with low incomes are more vulnerable to hardships and may depend on public land in unique ways. Relative to the United States (15 percent) and Colorado (13 percent), the social and economic area of influence had a higher share of residents and families living below the poverty line in the time period of 2011–2015 (18 percent) (Table 94). The San Luis Valley area of influence had an average poverty rate equal to the social and economic area of influence, however, several counties in the San Luis Valley area of influence had particularly high poverty rates: Alamosa, Conejos, Costilla, and Saguache all had poverty rates above 23 percent. Alamosa had the highest rate at 29 percent during this time period (2011–2015). These values are 10–16 percentage points higher than Colorado's average.

Table 94. Poverty rates, ACS 5 year (2011–2015)

[Source: U.S. Census Bureau (2016)]

	People Below Poverty	Families Below Poverty
Colorado	13%	8%
Alamosa	29%	18%
Archuleta	12%	10%
Conejos	24%	21%
Costilla	24%	21%
Custer	17%	13%
Fremont	17%	14%
Gunnison	17%	9%
Hinsdale	8%	3%
La Plata	11%	5%
Mineral	8%	1%
Montrose	19%	14%
Rio Grande	19%	15%
Saguache	23%	17%
San Juan	17%	9%
New Mexico	21%	16%
Rio Arriba	24%	17%
Taos	24%	17%
San Luis Valley area of influence	18%	13%
Social and Economic area of influence	18%	12%
United States	15%	11%

In short, both the social and economic area of influence and the San Luis Valley area of influence have higher-than-average unemployment, lower median and per capita incomes, low annual wage earnings, and high poverty levels. These data indicate that both the social and economic area of influence as a whole, and the San Luis Valley area of influence, are facing greater economic insecurity than both Colorado and the Nation.

Earnings

There are two major sources of personal income: (1) labor earnings or income earned through employment and (2) non-labor income (discussed below). Labor Earning's share of personal income decreased from 69 percent in 1970 to 54 percent in 2013 (U.S. Department of Commerce 2014 as reported in Assessment 6). Although wages can fluctuate between counties and across industries, the average annual wage in the Forest social and economic area of influence was below those of Colorado and the Nation in 2015 (U.S. Bureau of Labor Statistics 2017a). In 2015, the average annual wage for the social and economic area of influence was $30,677, and the average annual wage ranged from $20,594 in San Juan County to $42,812 in La Plata County (U.S. Bureau of Labor Statistics 2017a) (Table 95). In comparison, in 2015 the United States' average annual wage was $52,876, Colorado's was $54,518, and New Mexico's was $41,225 (U.S. Bureau of Labor Statistics 2017a). The San Luis Valley area of influence had a similar average annual wage as the social and economic area of influence, $30,139 (U.S. Bureau of Labor Statistics 2017a).

Table 95. Average annual wages, 2015

[Source: U.S. Bureau of Labor Statistics (2017a)]

	All Industries	Goods Producing	Services
Colorado	$54,518	$64,455	$52,625
Alamosa	$34,727	$34,907	$34,697
Archuleta	$29,482	$31,858	$29,133
Conejos	$30,472	$36,230	$28,768
Costilla	$29,302	$43,719	$24,185
Custer	$30,096	$43,297	$25,262
Fremont	$30,392	$46,862	$27,250
Gunnison	$33,001	$51,781	$28,588
Hinsdale	$26,772	$35,126	$23,313
La Plata	$42,812	$55,822	$39,815
Mineral	$26,524	$36,171	$25,921
Montrose	$34,452	$40,193	$32,717
Rio Grande	$33,437	$30,523	$35,185
Saguache	$29,739	$29,748	$29,730
San Juan	$20,594	$38,137	$18,677
New Mexico	$41,225	$52,882	$38,792
Rio Arriba	$30,435	$29,884	$30,497
Taos	$28,601	$33,782	$28,083
San Luis Valley area of influence	$30,139	$35,203	$28,828
Social and Economic area of influence	$30,677	$38,628	$29,448
United States	$52,876	$61,478	$51,050

Non-labor income is income received from sources other than an employer. In general there are four categories of non-labor income: (1) investment income (dividends, interest, and rent payments), age-related transfer payments (Social Security and Medicare), hardship-related transfer payments (Medicaid and other medical assistance, income maintenance or “welfare” and unemployment compensation), and other transfer payments (Veterans benefits, education and training assistance, and all other payments including workers’ compensation). Non-labor income’s share of personal income has grown in recent years. In 1970 non-labor income accounted for 31 percent of personal income within the original 18-county social and economic area of influence (as reported in Assessment 6), and by 2013 non-labor income had grown to represent more than 46 percent of personal income (U.S. Department of Commerce 2014). As discussed above, the population surrounding the Forest is older than the general population, and the region’s median age is likely to continue to rise. As the region’s baby boomer population grows, age-related transfer payments as a share of income from non-labor sources is also likely to rise in the social and economic area of influence.

Low incomes are due, in part, to the lack of high-paying job availability in the San Luis Valley area of influence. Wages in the goods-producing sector are generally higher than in the service industry. In the social and economic area of influence, goods-producing employing wages are approximately $9,000 higher than in the service industry in 2015 (Table 95).

Federal Payments to State and Counties

Local governments, municipalities and residential members of the community depend upon a variety of goods and services from the Forest. Of these, federal payments to counties in the social and economic area of influence are among the most vital. These payments can be categorized into two types: receipt-sharing and per acre federal land payments. Receipt-sharing programs have been administered under the Secure Rural Schools and Community Self-Determination Act and the Twenty-Five Percent Fund Act of 1908. In addition to receipt-sharing, the Payment in Lieu of Taxes (PILT) program provides payments to counties to offset losses in tax revenues due to the presence of tax-exempt federal land in their jurisdictions. Receipt-sharing and per acre federal land payments received by social and economic area of influence counties can be highly variable. The degree of variation in PILT and SRS payments across social and economic area of influence counties is demonstrated in Table 96. Payments from the Forest occur almost exclusively to counties in the San Luis Valley area of influence.

Although rural communities in these counties rely on these funds to balance tight budgets, the PILT program has reverted back to a discretionary program that is highly susceptible to federal funding shortages. These payments represented a large portion of county revenues. In FY 2014 they ranged from 1 percent (Alamosa County) to 20 percent (Saguache County) of total county revenue (see Assessment 6 for further details). If these funding streams were eliminated, it would have widespread economic consequences. On average, 25-percent fund estimates for FY 2016 are 87 percent less than SRS payments for the social and economic area of influence. This would reduce county income by $1.5 million dollars across the social and economic area of influence. If all SRS payments to the social and economic area of influence are included, the total loss would be $6.5 million, $2.6 million of which goes to the San Luis Valley area of influence counties. Individual county payments are listed in Table 96.

Table 96. Federal payments from the Forest

[Source: U.S. Department of Interior (2016) and USDA Forest Service (2015). Note: 2016 SRS payments were not yet available in April 2017.]

County	Total SRS Payments (2015)	SRS Payments based on Forest lands (2015)	Total PILT Payments (2016)	PILT Payments based on Forest lands (2016)
Alamosa	$24,105	$24,105	$193,671	$53,757
Archuleta	$378,652	$16,211	$1,098,545	$58,131
Conejos	$423,692	$353,600	$1,109,038	$662,721
Costilla	$564	$0	$982	$0
Custer	$121,507	$0	$395,412	$0
Fremont	$134,608	$0	$1,086,647	$0
Gunnison	$1,017,121	$0	$592,480	$0
Hinsdale	$404,884	$131,355	$140,932	$40,983
La Plata	$210,997	$0	$590,152	$0
Mineral	$225,542	$168,693	$124,984	$91,310
Montrose	$341,008	$0	$2,226,663	$0
Rio Grande	$236,736	$214,023	$783,740	$657,618
Saguache	$1,295,447	$741,416	$727,251	$328,861
San Juan	$208,820	$22,361	$79,333	$8,099
Rio Arriba	$1,790,292	$0	$2,227,564	$0
Taos	$585,254	$0	$1,644,099	$0
Total	$7,399,229	$1,671,763	$13,021,493	$1,901,480

Factors of Social and Economic Sustainability in the Forest's Area of Influence

National forests are productive assets that contribute to sustaining the viability of national, regional, and local communities. Uses, products, services, and visitor opportunities supported by National Forest System lands produce a steady flow of benefits that contribute to the robustness and sustainability of local communities. While robustness implies diversity, sustainability refers to the community's capacity to maintain a certain level of function within the social, ecological, and economic systems it encompasses.

What is Social Sustainability?

Sustainability is a complex idea focused around intergenerational equity. The 2012 Planning Rule defines social sustainability as *the capability of society to support the network of relationships, traditions, culture, and activities that connects people to the land and to one another and supports vibrant communities* (36 CFR §219.19). Social sustainability can be broad and complex and can often not be easily measured and addressed. This is in large part due to the differing sustainability desires and values people hold, how they connect to the landscape, and how they would like to see the Forest contribute to their definition of vibrant communities.

The factors of social sustainability can differ amongst individuals; however, generally many factors relate to interactions and relationships, culture, leisure, amenities income, employment and job satisfaction, affordable housing, and health. One way of examining social sustainability is to understand the views and values held by individuals or groups and how they would like the Forest to contribute to social sustainability. Generally, the value people assign to forest resources is the measure used to assess if alternatives will have positive or negative impacts to various individuals or groups. There are many definitions of value; for this effort, it is assumed that we can understand forest values by understanding what is important to people (USDA Forest Service 2003). Brown and Reed (2000) developed a list of 13 value typologies of forest values that individuals may hold for any forest resource or opportunity (Table 97).

Table 97. Forest values that people might hold

Forest Value	Description of Why People Hold this Value
Aesthetic	Value the forest because of the scenery, sights, sounds, smells, etc.
Biological Diversity	Value the forest because it provides a variety of fish, wildlife, plant life, etc.
Cultural	Value the forest because it is a place to practice, and pass down wisdom and knowledge and traditions
Economic	Value the forest because it provides timber, minerals, oil/gas/coal, and tourism opportunities (outfitter/guides)
Future	Value the forest because it allows future generations to experience the forest as it is now.
Historic	Value the forest because it has places and things of natural and human history that are important
Intrinsic	Value the forest in and of itself, just to know it exists, no use is needed to gain value
Learning	Value the forest because one can learn about the environment through scientific observation or experimentation
Life sustaining	Value the forest to produce, preserve, clean and renew air, soil and water
Recreation	Value the forest because it provides a place for outdoor recreation activities
Spiritual	Value the forest for sacred, religious, or spiritually special places, and for providing a feeling of reverence and respect for nature
Subsistence	Value the forest because it provides necessary food and supplies to sustain life for individuals
Therapeutic	Value the forest for physical and/or mental health

While the above list of value typologies is not exhaustive, it does provide a glimpse at the variety of values individuals or groups may hold toward Forest resources and resource uses. All of these are valid values and many of us hold several to all of them. Conflicts surrounding forest resources, resource uses, and management commonly stem from how individuals/groups prioritize their values—one may prioritize his/her value of recreational opportunities over his/her historical value of an area. Additionally, these are broad and somewhat simplistic value typologies, and there can be conflicts within a value typology such as conflict between people’s values of different recreational opportunities. What people value and how they prioritize their values helps to determine what they would like to see the Forest contribute to social sustainability and if the values they prioritize exist in the surrounding area.

What Is So Different About Economic Sustainability?

It is not how big you grow, but *how* you grow big that matters when it comes to sustainability—which requires reaching a balance between efficiency and resilience: where, an economy that lacks efficiency risks being stagnant, while a lack of diversity reduces resilience (Goerner et al. 2009). Consequently, putting the concept of economic sustainability into practice—or at least being able to earnestly measure progress toward sustainability—requires clear distinction differentiating healthy, long-term economic development from the sheer numeric growth in outputs (Saisana and Philippas 2012; Ng 2014; Ng 2015). Traditional metrics on economic growth such as total output overlook the network structure needed to process resources and circulate energy to all parts of the whole, so by relying on these measures alone, it is not possible to differentiate a bubble or unstable economy from a resilient one (Daly 1997; Goerner et al. 2009). As the 2012 Planning Rule (36 CFR §219.19) defines sustainability as *the capability to meet the needs of the present generation without compromising the ability of future generations to meet their needs*, the concepts of economic diversity and efficiency are germane and should be considered in order to describe the Forest’s contribution to economic sustainability.

Indicators for Evaluating Economic Sustainability in The Forest’s Area of Influence

Resilience is related to the concept of diversification in modern portfolio theory. For example, an economy or labor force that over-relies on specialization in a single industry (i.e. putting all of one's eggs in a single basket) lacks diversity and resilience, thus diminishing its ability to recover from periodic disturbances such as economic downturns.

In similar way, efficiency is related to the ideas of productivity, connectivity, and specialization. When economies specialize, total output increases, potentially allowing for greater levels of enjoyment and consumption, thereby increasing the standard of living. An economy that lacks efficiency and productivity risks being stagnant. The United States has been experiencing weak growth in productivity in recent decades (U.S. Bureau of Labor Statistics 2017b). This is especially worrisome because productivity growth is a crucial determinant of living standard for future generations.

With the concepts of resilience and efficiency in mind, this section focuses on indicators that can provide important insights on economic sustainability in the Forest’s area of influence. Measures include labor force forecasts by sectors, indices on economic diversity (Shannon-Weaver Index, Creative Employment) (Shannon and Weaver 1949), specialties (Base Industries Analysis, County Typology Codes) (USDA Economic Research Service 2017), and productivity. Each of these factors, for each county, is listed in Table 98.

Table 98. Factors of economic sustainability in the Forest's area of influence

[Source: USDA Economic Research Service (2016), Headwater Economics (2015), and IMPLAN (2014)]

County	Market Access Classification	Economic Dependence Typology	Creative Class Employment	GDP per Worker (Thousands of 2016 $)	GDP per Worker National Ranking (out of 3,110 counties)	Shannon -Weaver Diversity Index
Alamosa	Isolated	Government-dependent	14.6%	93.9	1,582	0.66485
Conejos	Isolated	Farm-dependent	11.6%	58.4	3,043	0.60982
Costilla	Isolated	Farm-dependent	15.2%	59.1	3,035	0.57825
Hinsdale	Isolated	Recreation	30.1%	52.4	3,105	0.5842
Mineral	Isolated	Recreation	27.3%	55.5	3,078	0.55051
Rio Grande	Isolated	Nonspecialized	18.6%	90.3	1,784	0.62859
Saguache	Isolated	Farm-dependent	15.0%	78.2	2,381	0.58718
Archuleta	Isolated	Recreation	22.4%	63.7	2,934	0.67737
Custer	Isolated	Recreation	23.1%	57.7	3,050	0.64795
Fremont	Isolated	Government-dependent	19.4%	83.2	2,128	0.67645
Gunnison	Connected	Mining-dependent	28.4%	72.6	2,644	0.67537
La Plata	Connected	Recreation	29.9%	98.9	1,316	0.72309
Montrose	Connected	Nonspecialized	18.9%	80.3	2,284	0.72483
San Juan, CO	Isolated	Recreation	35.9%	52.9	3,098	0.59056
Rio Arriba, NM	Isolated	Nonspecialized	19.5%	78.5	2,366	0.66039
Taos, NM	Isolated	Recreation	26.9%	77.4	2,421	0.70712

Market Access and Connectivity

While recreation opportunities and natural amenities bring visitors, retirees, and tourism-related businesses to rural areas, the remoteness of an area typically presents challenges to economic development due to limited availability of transportation infrastructure and access to market. Research shows there are three different types of counties in the West, defined by their access to major markets and population centers: (1) "Metro": counties classified by the Office of Management and Budget as metropolitan statistical areas, (2) "Connected": non-metro counties with population centers that are within a one-hour drive of the nearest major airport with daily passenger service, and (3) "Isolated": non-metro counties further than a one-hour drive from the nearest major airport with daily passenger service (Headwater Economics 2015).

All seven counties within the San Luis Valley area of influence fall entirely in the "isolated" category. When other counties within the broader economic zone of influence are considered, all are "isolated" with the exceptions of Gunnison, La Plata, and Montrose Counties, which are in the "connected" category.

Communities within these isolated counties are not necessarily destined to slow growth or economic woes; nevertheless, they are less likely to share the same magnitudes and pace in terms of growth, compared with those experienced along the Front Range, for instance.

County-Level Economic Dependence Typology

County-level typology codes, as developed by the USDA Economic Research Service (ERS), classify all U.S. counties according to six mutually exclusive categories of economic dependence. The economic dependence types include farming, mining, manufacturing, Federal and State government, recreation, and nonspecialized counties. The ERS classification criteria are as followed:

- Farming dependence was based on two thresholds—farm earnings accounting for an annual average of 25 percent or more of total county earnings, or farm employment accounting for 16 percent or more of total employment.
- Mining dependence was based on the mining industry accounting for an annual average of 13 percent or more of total county earnings or 8 percent or more of total county employment.
- Manufacturing dependence was based on the manufacturing industry accounting for an annual average of 23 percent or more of total earnings or 16 percent or more of total employment.
- Federal and State government dependence was also based on Federal and State governments accounting for an annual average of 14 percent or more of total county earnings or 9 percent or more of total employment.
- Recreation counties were computed using three data sources: Percentage of wage and salary employment in entertainment and recreation, accommodations, eating and drinking places, and real estate as a percentage of all employment reported by the Bureau of Economic Analysis; Percentage of total personal income reported for these same categories by the Bureau of Economic Analysis; and Percentage of vacant housing units intended for seasonal or occasional use as reported in the 2010 Census.
- Nonspecialized counties were counties that did not qualify for either the farming, mining, manufacturing, Federal/State government, or recreation county types.

Across the San Luis Valley area of influence, Conejos, Costilla, and Saguache are considered farm-dependent counties and Hinsdale and Mineral are considered recreation counties; Alamosa County is Federal/State government-dependent and Rio Grande County is nonspecialized. The rest of the counties within the broader economic area are either recreation-dependent or nonspecialized, with the exceptions of Gunnison (mining-dependent) and Fremont (government-dependent). None of the counties belong in the manufacturing-dependent category.

Creative Class Employment

The creative class thesis—that towns need to attract engineers, architects, artists, and people in other creative occupations to compete in today's economy—may be particularly relevant to rural communities, which tend to lose much of their talent when young adults leave. The USDA ERS creative class codes indicate a county's share of population employed in occupations that require "thinking creatively." Variables used to construct the ERS creative class measure include number and percentage of people employed in creative class occupations. Occupation titles belonging to the creative class represent skill element defined as: developing, designing, or creating new applications, ideas, relationships, systems, or products, including artistic contributions. These job titles range from advertising, marketing, promotions, public relations, and sales managers; architects, surveyors, and cartographers; to artists, entertainers, performers, sports, and media-related workers (USDA Economic Research Service 2017).

About 19 percent of all employments within the San Luis Valley area of influence belong in the creative class, with Hinsdale County (30 percent) in the lead. The share of employments in the creative class is 22 percent when counties within the broader economic zone of influence are considered, with San Juan County, Colorado, at the top (40 percent). The national and state (Colorado) averages are about 18 percent and 23 percent, respectively.

Measures of Productivity

While Gross Domestic Product (GDP) measures economic output at a point in time, GDP per worker is a measure of productivity. Computed from data obtained from the U.S. Bureau of Economic Analysis (BEA) and Indiana Business Research Center GDP-county-complete estimates, GDP per worker and rankings (out of 3,110 counties) are presented for counties within the San Luis Valley and broader economic areas (Indiana Business Research Center 2016). With $93,900 per worker, Alamosa County has the highest GDP per worker value, which is close to the national average of $94,400. Costilla, Conejos, Mineral, and Hinsdale Counties are all well below national average. Out of 3,110 counties in the United States, Hinsdale ranked 3,105 in 2016.

While sustainability requires reaching a balance between efficiency and resilience, and efficiency is related to the ideas of productivity, connectivity, as well as specialization, local economies that lack efficiency and productivity risk being stagnant. Low productivity rankings across the San Luis Valley area are source of concern because productivity growth is a crucial determinant of living standard for future generations.

Economic Diversity

An economic diversity index based on the Shannon-Weaver entropy function (Shannon and Weaver 1949) is calculated for counties within the San Luis Valley and the broader economic zone of influence using 2014 IMPLAN data (Table 98). The entropy method, such as the Shannon-Weaver Diversity Index, measures the diversity of a region against a uniform distribution of employment, where a measure of the extent to which the employment of a region is distributed among its industries. It ranges from 0 (perfect inequality or no diversity) to 1 (perfect equality or diversity).

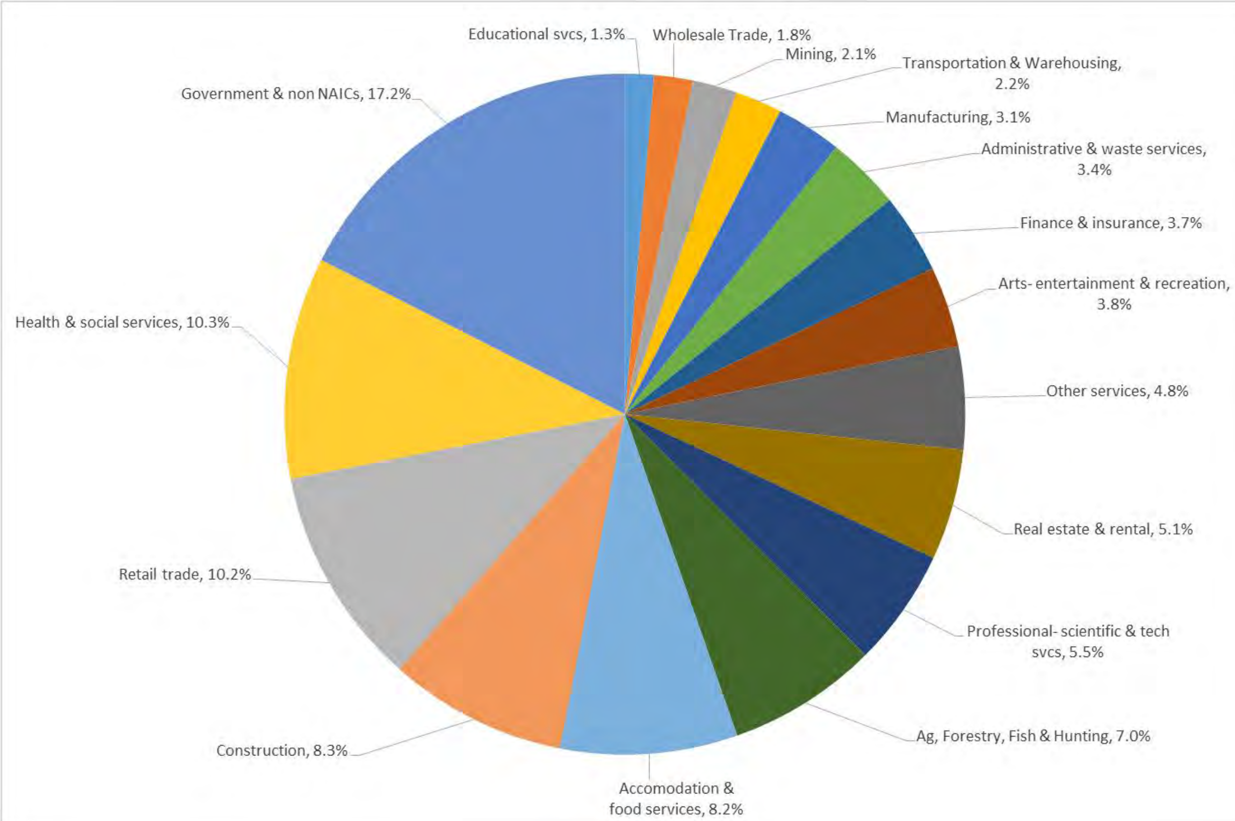
In other words, because the Shannon-Weaver Diversity Index accounts for both numbers of industries and the spread of employment across them (Attaran 1986), it is a valuable indicator that can provide insights into the economic sustainability of an area.

The Shannon-Weaver Diversity Index for the State of Colorado is 0.75766. Counties within the broader economic zone of influence are more economically diverse as compared with those within the San Luis Valley area. Mineral, Costilla, Hinsdale, and Saguache Counties have the lowest economic diversity (index ranged from 0.55 to 0.58) across 17 counties within the broader economic zone of influence.

These indices should be viewed in context with the other indicators presented in this analysis, such as the labor base industries analysis and county typology codes. Because this index does not account for the fact that many of the industries in a region may be closely related, it would therefore provide little protection were one of the other closely related industries to suffer a major decline. The city of Detroit is a well-known example, where the surrounding area has a relatively high Shannon-Weaver index—indicating economic diversity. But the high interdependence of the majority of the industries is due to just one economic behemoth—the automobile industry. Indeed, employment may be shared across a variety of industries, but they are all closely tied to just one, struggling industry. The lesson to be learned from this example is that the Shannon-Weaver index is of great value and utility, but it should be viewed along with other information such as base industries analysis.

Employment by Industry

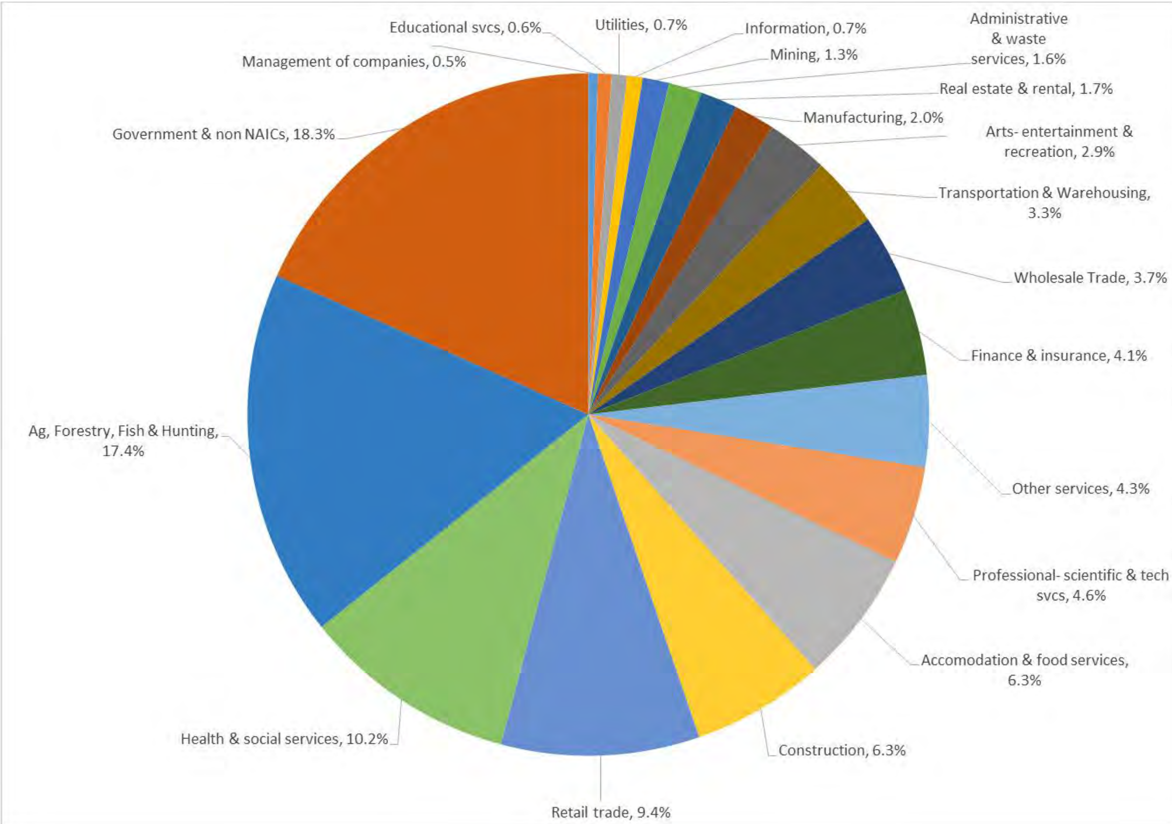
Since economic diversity generally promotes stability and offers greater employment opportunities, assessing employment by sector helps identify industries that are important to the local economy surrounding the Forest. Local employment in aggregated sectors as a share of total employment is shown in Figure 19 (IMPLAN 2014). In 2014 the government (17 percent), health and social services (10.3 percent), and retail trade (10.2 percent) sectors were the largest employers within the 18-county social and economic area of influence. Since 2012, health and social services has overtaken retail trade as the number 2 industry sector.



Source: IMPLAN (2014).

Figure 19. Employment by industry, all counties, 2014

Unlike the social and economic area of influence, the San Luis Valley area of influence's largest sectors are government (18 percent), agriculture (17 percent), health and social services (10.2 percent), and retail trade (9 percent). Employment specialization is of particular interest when it occurs in sectors related to forest management. A portion of employment in the sectors shown in Figure 20 can be attributed to forest management, timber production, grazing, and recreation on the Forest. Sectors related to timber include forestry and logging (IMPLAN sectors 15, 16, 19, 335), primary forest products manufacturing (IMPLAN sectors 31, 95, 96, 98, 105), and secondary forest products manufacturing (IMPLAN sectors (97, 99, 100, 102, 106, 107, 108, 109, 110, 111, 112, 295, 297, 301, 302). Sectors related to grazing include cattle ranching and farming (IMPLAN sectors 11) and animal production, except cattle and poultry and eggs (IMPLAN sectors 14). The government sector includes all federal, state, and local employment, while a portion of employment in the accommodations and food services, arts, entertainment and recreation, retail trade, and passenger transportation sectors is specifically attributed to tourism and recreation (Marcouiller and Xia 2008 as reported in Assessment 6). Relative to the states of Colorado and New Mexico, the economic area of influence is specialized in all sectors related to forest management apart from primary and secondary forest products manufacturing.



Source: IMPLAN (2014).

Figure 20. Employment by industry, San Luis Valley area of influence, 2014

A portion, but not all, of employment shown in Figure 19 and Figure 20 can be directly or indirectly attributed to the Forest; employment contributions provided by the Forest are discussed in detail in the *Forest Contributions to Social and Economic Sustainability* section.

While the local economy surrounding the Forest contains many counties with lower-paying service jobs, the unique natural and cultural amenities of the Forest may provide additional benefits to individuals that help offset these low wages. Living in close proximity to the Forest provides residents with greater access to open spaces, wildlands, and a wide range of recreational opportunities. While local residents may forego higher-paying jobs in areas with fewer natural amenities, they gain personal enjoyment from the outdoor experiences they have on the Forest. Natural amenities, often provided by public lands, have been found to influence population and employment changes in amenity-rich communities (Knapp and Graves 1989, Clark and Hunter 1992, Treyz et al. 1993, Mueser and Graves 1995, McGranahan 1999, Lewis et al. 2002). As a steward of Colorado's unique natural and cultural amenities, the Forest increases the attractiveness of local communities and increases regional well-being (as reported in Assessment 6).

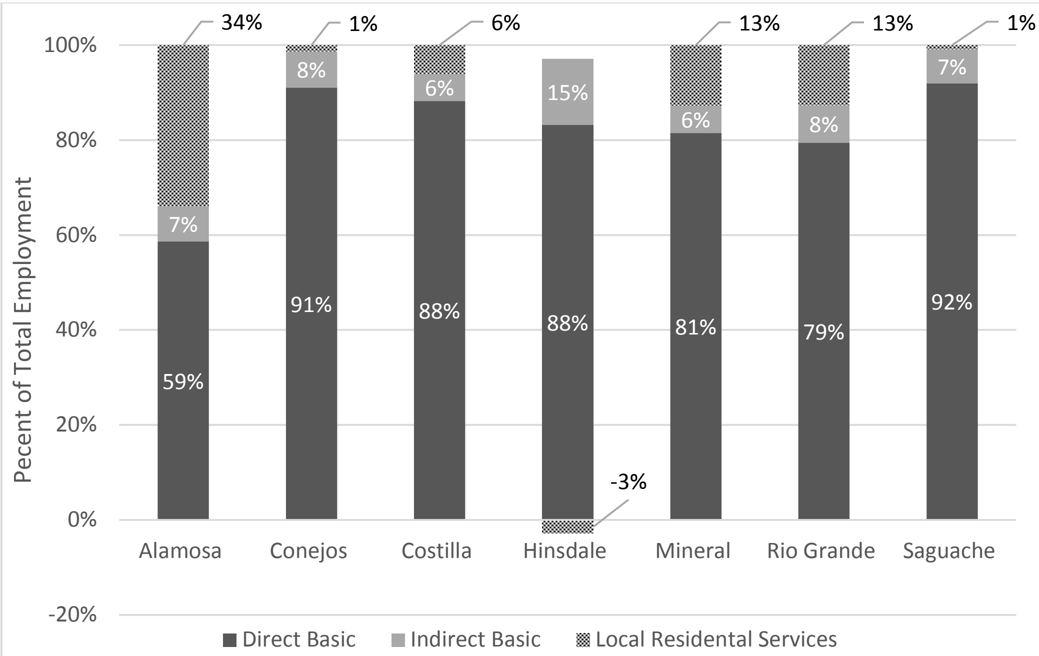
Economic Base Analysis

An economic base analysis provides detailed information on local economic industries, which industries are the driving force of the economy, and which industries survive because the base industry exists. Base industries are important because they bring outside dollars to an economy, much like an export, and serve as an anchor for other industries, which would otherwise not exist. For example, agricultural products grown in the region are sold to firms outside of the local area, or dollars spent by tourists from other regions are spent in the local community. Additionally, a base industry is any income received by local residents from outside the local area, such as social security payments or retiree pensions.

The economic base analysis conducted by the Colorado Demographers Office has been defined as follows (Colorado Department of Local Affairs 2011). First, there is the **Direct Basic** economy; as discussed above, this is the driver of growth, the industry that exports its goods or services outside the local economy and brings in outside dollars. Second is **Indirect Basic Employment**; this is the spending Direct Basic employment dollars on local services and supplies that operate the Direct Basic business. For example, a rancher may buy feed from a local supply store. The local supply store would not exist if it weren’t for the base industry, agriculture. The third way base industries generate employment is through **Local Residential Services Employment**. Basic Industries and their employees will use their earnings to pay taxes for police, educators, and other public services; they will also use earnings to pay for medical services, buy groceries, and fuel their cars (Colorado Department of Local Affairs 2011).

- **Direct Basic Industry Sectors:** Agriculture, manufacturing, mining, construction, government, regional services, tourism, and retiree income. Regional services are industries that may provide Direct Basic services/goods to outside consumers, and services and employment to local residents. For example, telephone services. Outside dollars may be used to maintain telephone services to nonlocal residents and to employ local residents, and would also be used to support Direct Basic industries.
- **Indirect Basic Industry Sectors:** Local stores, services, goods, labor, etc. that are needed to support the Direct Basic Industry.
- **Local Residential Services:** Services paid for by earnings, taxes, rents, etc. of Basic Industries and their employees.

The percentage of total employment in Direct Basic, Indirect Basic, and Local Services industries for the San Luis Valley area of influence is provided in Figure 21. With the exception of Alamosa County, employment is heavily concentrated in the Direct Basic economy.



Source: Colorado Department of Local Affairs (2017b).

Note: Negative value associated with Local Residential Services Hinsdale is the result of local residential services being purchased primarily outside of the county.

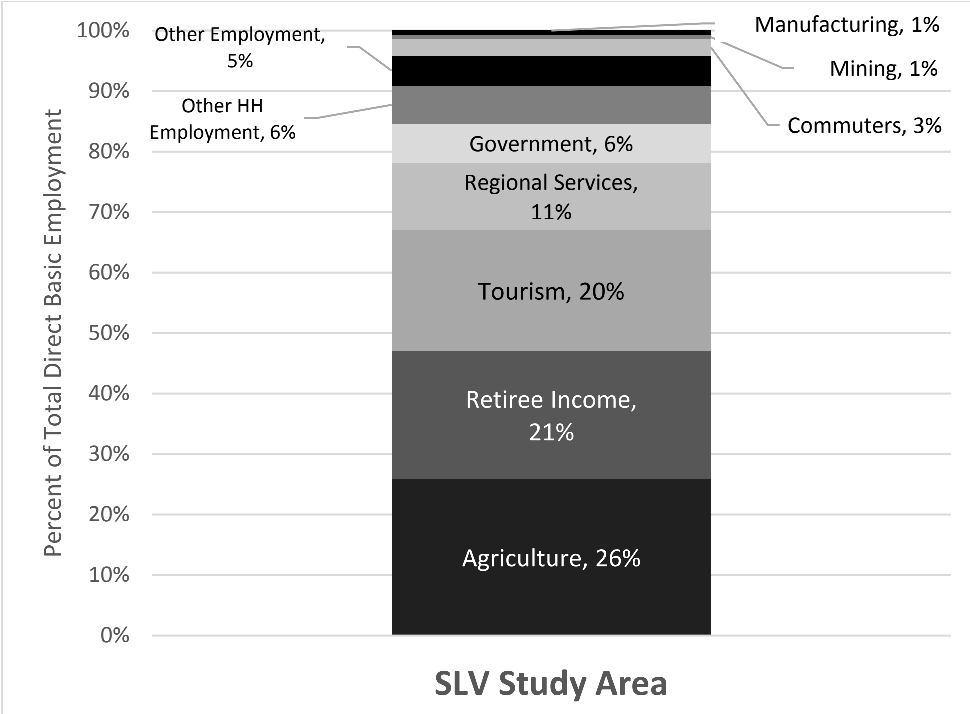
Figure 21. Base economy, 2014

A visual representation of San Luis Valley area of influence Direct Basic Industries is provided in Figure 22. Additionally, information on base industries by county is provided in Table 99. Understanding what the base industries of an economy are, their current and future prospects, and for forest planning, how these industries might be impacted by Forest projects and activities, will contribute toward a developed understanding of the local economy.

Agriculture, retiree income, and tourism are the top three Direct Basic Sectors in the San Luis Valley area of influence (Figure 22). These top three industries are unsurprising because the agricultural and tourism industries (accommodation, food services, and retail trade) are some of the largest employers in the San Luis Valley area of influence. Additionally, the San Luis Valley is considerably older than both Colorado and the United States, and reliance on pension and social security transfer payments is expected.

Retirement income as a base industry will have significant long-term implications on the San Luis Valley area of influence. As retirees and their income (particularly baby boomers), become a larger, and then smaller portion of Direct Basic Employment, it will have a large impact on Indirect and Local Residential Services, particularly, health care, residential services, and local government activities and services supported by their taxable income.

Tourism is also a large Direct Basic employer in the San Luis Valley area of influence. As such, Forest management directions that would reduce access or visitation opportunities would have a large Direct and Indirect impact on local community’s employment opportunities.



Source: Colorado Department of Local Affairs (2017b).

Figure 22. Direct basic industries, 2014

Table 99. Direct basic industries, 2014

[Reported as the percentage of Direct Basic employment. Source: Colorado Department of Local Affairs (2017b)]

	Alamosa	Conejos	Costilla	Hinsdale	Mineral	Rio Grande	Saguache
Agriculture	18%	30%	37%	5%	5%	40%	46%
Mining	0%	1%	0%	3%	1%	0%	0%
Manufacturing	1%	1%	1%	0%	0%	1%	1%
Government	24%	3%	2%	3%	2%	7%	3%
Regional Services	32%	10%	8%	10%	3%	12%	5%
Tourism	14%	8%	3%	33%	68%	8%	5%
Commuters	-10%	20%	10%	0%	-14%	2%	11%
Other Household Employment	4%	8%	11%	6%	3%	6%	6%
Retiree Income	13%	17%	24%	31%	25%	19%	20%
Other Employment	3%	3%	4%	10%	7%	4%	4%

Civilian Labor Force Projection

On account of both falling fertility rates and modest increases in net international migration, the U.S. population will be slower growing, older, and more diverse over the next four decades (Colby and Ortman 2014). In addition to the overall population trends, it is also useful to examine the future labor force across the San Luis Valley area of influence, especially tourism-related employment demand. This information is particularly valuable for rural and recreation-dependent counties with a declining population. The projected civilian labor force for total labor demand, including a breakdown for those employments related to the tourism industry, through 2040 is presented in Table 100. This labor force projection by The Colorado Demographer's Office took into accounts of county-level population growth, multiple job holding rates, commuting, unemployment, and labor force participation. (Colorado Department of Local Affairs 2017c).

Table 100. Civilian labor force projection – total and tourism-related demand breakdown, 2015–2040

[Source: Colorado Department of Local Affairs (2017c)]

County	2015	2020	2025	2030	2035	2040
Alamosa (Total civilian labor demand)	9,902	10,539	11,052	11,566	11,965	12,341
Tourism-related jobs	836	862	829	831	840	865
Share (%) of tourism jobs	8%	8%	7%	7%	7%	7%
Conejos	2,537	2,670	2,730	2,740	2,750	2,754
Tourism-related jobs	176	181	171	168	167	169
Share (%) of tourism jobs	7%	7%	6%	6%	6%	6%
Costilla	1,290	1,323	1,330	1,303	1,276	1,249
Tourism-related jobs	37	39	38	39	41	43
Share (%) of tourism jobs	3%	3%	3%	3%	3%	3%
Hinsdale	410	435	456	486	522	572
Tourism-related jobs	122	131	131	134	136	141
Share (%) of tourism jobs	30%	30%	29%	27%	26%	25%
Mineral	693	829	825	823	794	783
Tourism-related jobs	384	400	388	380	374	374
Share (%) of tourism jobs	55%	48%	47%	46%	47%	48%
Rio Grande	5,329	5,413	5,381	5,344	5,320	5,294
Tourism-related jobs	348	341	310	296	288	290
Share (%) of tourism jobs	7%	6%	6%	6%	5%	5%
Saguache	2,733	2,873	2,912	2,881	2,851	2,824
Tourism-related jobs	131	137	131	130	131	135
Share (%) of tourism jobs	5%	5%	5%	5%	5%	5%
Total	22,894	24,081	24,685	25,142	25,477	25,815
Tourism component	2,035	2,090	1,998	1,978	1,976	2,017
Share of tourism	9%	9%	8%	8%	8%	8%

Hinsdale and Mineral are recreation-dependent counties (see *County-Level Economic Dependence Typology* section) and are expected to remain so in the foreseeable future. It is worth noting that the shares (percentage) of tourism labor demand are expected to decrease 5–10 percent for both counties, but for different reasons. For Hinsdale County, both tourism and total civilian employment demands are projected to increase, but that increase is projected to be greater for the overall civilian employment demand; for Mineral County, both tourism and total civilian employment demands are projected to decrease (after 2020), but the decline is projected to be greater for tourism-related jobs.

More specifically, the total labor demand for Hinsdale County is projected to grow at an average rate of 1 percent over the next three decades, but job growth related to the tourism industry will remain flat. For Mineral County, total labor demand is projected to increase for the next few years before dipping minimally after 2020, with a relatively stable demand for tourism-related jobs. Across the San Luis Valley area, total labor demand is projected to increase at an annual rate of about 1 percent until around 2020, before stabilizing at an annual growth rate of less than 0.3 percent; while the demand for tourism-related jobs is not projected to change distinctively.

No one single indicator should be perceived as an adequate measure of economic sustainability; therefore, none of the above measures should be used in isolation to claim a county's overall economic health. Thoughtful discussion and examination of these indicators, however, can provide important contexts for the evaluation of the different potential contributions toward economic sustainability from each alternative. For an inclusive summary for each county within the San Luis Valley area of influence, see the *County-Level Summaries on Social and Economic Sustainability and Plan Area Contributions* section.

Forest Contributions to Social and Economic Sustainability

Management of the plan area contributes to social and economic sustainability in the area(s) of influence and the broader landscape primarily through the provision of (1) multiple uses, (2) ecosystem services, (3) infrastructure, and (4) Forest Service presence in the community (FSH 1909.12, ch. 20, sec. 23.21 and FSH 1909.12, ch. 10, sec. 13). The conditions and trends of these major contributions are described below.

Multiple Uses and Ecosystem Services

Multiple uses and ecosystem services are two of the major contributions to social and economic sustainability of the Forest in the broader landscape. While ecosystem services are components of nature that contribute to human well-being, and multiple uses include outdoor recreation, range, timber, watershed, wildlife, and fish, these contributions are closely intertwined and best described in an integrated manner.

The concept of ecosystem service intends to bring explicit awareness and recognition of the various ways that humans benefit from and depend on the natural world. This dependency extends from essential support for life (oxygen, water, and food) to security (e.g., natural regulation of insects, disease, and fire regime) and quality of life (scenic beauty and other cultural services such as outdoor recreation and spiritual values). Understandably, all biotic recourses in existence are important and contribute to human well-being directly or indirectly. In order to have a more operationally focused way of defining, classifying, and measuring ecosystem services, the concept of Final Ecosystem Goods and Services was developed. Final Ecosystem Goods and Services are the components of nature, directly enjoyed, consumed, or used to yield human well-being (Boyd and Banzhaf 2007). This analysis draws partly on this concept as it facilitates a more explicit discussion on the relationship between landscape, resources, and beneficiaries—people who obtain benefits from nature (Ng and Miller 2014).

When considering ecosystem services in forest plans, it is Forest Service policy to identify and consider a set of key ecosystem services provided by the plan area, rather than trying to identify and evaluate information about all ecosystem services that may be present in the plan area (FSH 1909.12, ch. 10, sec. 13.12). In the effort to better focus and highlight contributions of national forest management, key ecosystem services are defined as those services that are important in the area(s) of influence or the broader landscape and, are likely to be influenced by the land management plan.

A set of key ecosystem services to be considered in this analysis was identified in Assessment 7 – Ecosystem Services. The conditions and trends of these services—along with components of multiple uses—are described here with special emphasis on the various ways they contribute to people, communities, and ultimately social and economic sustainability.

Forage for Grazing

Today, agriculture continues to play an important economic and social role; area residents identify with the tradition, land-use, and history. The number of cattle and sheep operations decreased across Colorado from 2007 to 2012 (from 14,685 to 13,970 cattle operations and from 1,600 to 1,509 sheep operations). The most recent USDA Census of Agriculture reports that Montrose and Conejos Counties were Colorado's 10th and 24th largest cattle producers, containing 2.1 and 1.0 percent of the total state cattle inventory (USDA 2012).

The social and economic area of influence counties in Colorado accounted for 8 percent of the state's 2012 total cattle inventory and 9 percent of the state's sheep inventory. Counties in New Mexico accounted for 2 percent of the state's 2012 total cattle inventory and 3 percent of the state's sheep inventory (USDA 2012). It is estimated that 31 percent (581,556 acres) of the Forest is suitable for grazing and would support a maximum of 143,077 animal unit months.

In 2016, 126 permittees grazed on Forest lands in seven counties (Archuleta, Conejos, Hinsdale, Mineral, Rio Grande, Saguache, and San Juan). The number of animal unit months grazed totaled 75,684 cattle and 8,238 sheep.

See the grazing specialist report for more details on historical trends and data.

Mineral Activities

Mining has played an important role in the area's history and early economic growth (see Assessment 13 – Cultural and Historic Resources and the specialist report for details) and the Forest does provides a variety of mineral uses (discussed in Assessment 10 – Energy, Minerals, and Geologic Hazards (USDA Forest Service 2016)). These uses include **locatable** mineral operations (silver or gold mining), **salable** mineral material (providing stone, gravel, and other material to the public with a permit), and **leasable** minerals (such as oil and gas). In addition, recreational mineral collection (panning, dredging, and sluice-box and metal detector use) occurs on the Forest. However, none of these mineral operations have been occurring on a large scale in recent history. The only exception is the Bulldog silver mine based out of Creede, Colorado, in Mineral County. This mine is situated on both private and Forest lands. Preliminary steps were taken for drilling and exploration during 2011–2013; however, the mine is currently not in operation and future mining would depend on a number of external factors, such as the market price of silver. Thirty-seven million ounces of resources have been confirmed to exist in the mine, and new targets suggest that in excess of 100 million ounces of resources may exist (Hecla 2017 and Rio Grande Mineral Specialist P. Moran, personal communication, 2017).

The Forest currently does not contribute to employment and income in the social and economic area of influence through mineral extraction. However, if silver mining were to resume in Mineral County, it would contribute to employment and income in the San Luis Valley area of influence. Additionally, if oil and gas production on Forest lands became economically viable, then these activities would support employment and income in the area. A brief explanation of locatable, salable, and leasable minerals on the Forest and their economic impacts is provided below.

Locatable Minerals: The only recently occurring commercial mining operation on the Forest is silver mining, which was taking place in Creede, Colorado, in Mineral County, as discussed previously. The Forest does not have any active coal mines within its boundaries, nor are there any known coal prospects on the Forest.

Salable Minerals: Contributions to sustainability from mineral uses on the Forest do occur. Salable mineral material is important to residents collecting material for personal use and also provides material for county and state road projects (stone and gravel is commonly used for road resurfacing projects). In addition, recreational mining and mining history attract visitors to the area.

Leasable Minerals: The only known leasable minerals on the Forest are oil and gas. While development potential has been evaluated and does exist, there is currently no leasable activity. For more discussion on this topic, see the *Renewable and Nonrenewable Energy and Minerals* section.

Outdoor Recreation, Tourism, Landscapes, and Features Providing Recreation and Scenery

The Forest has diverse recreational opportunities ranging from nonmotorized activities such as hiking, fishing, snowshoeing, and skiing to motorized activities such as dirt biking, four-wheeling, and snowmobiling. Forest lands include a variety of developed recreation sites, many areas for dispersed recreation, recreation rentals, seven of Colorado's "fourteeners," and several other unique recreation areas. For a complete description of recreation resources, tourism, and scenery on the Forest, see the appropriate sections of this analysis.

More than half the visits to national forests or grasslands nationwide are made by people who live within 50 miles, and two-thirds of visits to National Forest System lands are made by those who travel fewer than 100 miles (English et al. 2015). Given these facts, it is likely that as nearby populations increase, so too will local visits to National Forest System lands.

People living near National Forest System lands (within a 50-mile radius) have access to numerous benefits from these lands, including substantial recreational opportunities, and are the Forest Service's primary recreation customers. Indeed, people living within an hour's drive, or about 50 miles, of national forests and grasslands generally receive the greatest benefits from the ecosystem services and economic activity generated by those lands. About 15 percent of all visits are made by people who are frequent visitors; i.e., they report visiting a national forest at least 50 times per year, or roughly once per week. About 90 percent of frequent visitors to national forests live within 50 miles of the forest they visit; the most avid recreation users generally live in the zone closest to the forest (USDA Forest Service 2015, English et al. 2015).

More than 68 percent of Forest visitors in 2015 reported travelling from more than 100 miles away, and almost 37 percent of visitors traveled more than 500 miles. In contrast, slightly more than 25 percent of visitors originated from the local area within 50 miles of the Forest. Most visitors (70 percent) reported coming to the Forest from one to five times per year. More than 15 percent of respondents said that they visit from 6 to 20 times per year, and a small subset of 5 percent of visitors reported frequenting the Forest from 51 to 100 times annually.

The Forest is not considered to be an urban forest, with less than a million people within a 50-mile radius of the Forest boundary. The expected increase in annual local recreational visits from 2010 to 2020, based on constant population growth and local visitation rates, is less than 25,000 visits (English et al. 2015). National visitor use monitoring results from 2015 highlight little crowding reported from survey respondents (USDA Forest Service 2015).

Jobs supported by National Forest System lands are typically in small, rural communities and are therefore an important contribution to economic and social sustainability. Nonlocal recreation/tourism visitors bring new money into the local economy with their spending activity. Local recreationists spend money that is already counted in the economic statistics for the area. Within the Forest, the economic contribution by local recreation activity supports about 34 jobs annually, and recreation/tourism by nonlocal visitors supports an additional 515 total jobs annually. The labor income associated with these jobs is estimated at about $0.9 million annually for local recreation activity, and about $13.5 million annually for nonlocal visitor recreation/tourism activity.

One tool used by the Forest to encourage commercial tourism activity on National Forest System lands is the recreation special uses permit program. This program includes permits for noncommercial and commercial events, activities, and privately owned improvements on National Forest System lands. The *Sustainable Recreation* section includes a complete analysis of recreation special use permits. Special use permits can be authorized for temporary or long-term periods. Short-term events include recreation competitions and other commercial recreation gatherings that are temporary in nature. Long-term Forest permits include Wolf Creek Ski Area, outfitters and guides, and concessions. These types of commercial operations assist people who may not have the skills or abilities to engage in activities on their national forests, through hiring a guide or participating in an organized event or trip, allowing them access and enjoyment.

At this time, there are 32 outfitter and guide permits providing a variety of commercial services on the Forest (internal Forest Service INFRA report, accessed April 3, 2017). The Forest is currently experiencing increased requests for outfitter and guide and recreation event permits. To manage this demand, forest plan direction included in all action alternatives indicates that outfitter-guide special use permits would be issued based on available capacity within each special use authority. This increase in commercial activity highlights an increase in people interested in hiring guides or participating in organized activities and events, a trend likely to increase the number of jobs and amount of income contributed by the Forest to the local area. It is also a trend that may increase the competition of recreation opportunities between local users/noncommercial users and outfitter guides/commercial users. Crowding is not currently an issue, but if commercial uses continue to increase, crowding in popular areas may increase and need additional management.

Several general trends in the way people are recreating, and in demographic changes in the population, may be reflected in the local populations surrounding the Forest and may alter the current visitation patterns in the future.

The changes in demographics include an overall aging population, especially an increase in retirees. This may be reflected in both an increase in retirees living or relocating to the counties around the Forest, as well as more retirees traveling to recreate on the Forest.

Trends in the way people recreate or choose to use their leisure time include an increase in family use, including multi-generational families traveling together looking for a mix of activities to engage in during their vacation. The "staycation" remains a popular trend as people want to vacation close to home (within 50 miles) and find a place to relax. People, especially the "millennials," are not planning vacations in advance, but at the last minute to leave for a getaway. People are also looking for pet-friendly locations, as about two-thirds of U.S. adults have at least one pet that they wish to bring with them.

These types of trends may bring people who have not explored the Forest as a place to vacation or visit for trips that meet these needs—a place to go with little planning, a place that is pet friendly, and/or a place that allows larger groups and offers a variety of activities. Some commercial operations (outfitters/guides) may be able to take advantage of these new users and provide access to the Forest using a guide service that meets these needs.

Locally, communities around the Forest are concerned about trends in recent large wildland fires. Active fire seasons are seen as being detrimental to the recreation/tourism economy of the local communities. The impact of ongoing large fires can be difficult to recover from for small businesses. Many small businesses are also dependent on hunting season and these businesses are concerned about the downward trends in hunting participation by the younger generation. These concerns will continue to impact business and forest management into the future.

Cultural, History, and Sacred Sites

Beneficiaries of the Forest enjoy a high level of opportunity to express traditional, cultural, and spiritual values. The Forest provides these opportunities by employing a multiple use management strategy that allows for harvest of vigas and latillas, and fuelwood, livestock grazing, outdoor recreation, scenery, fishing, hunting, wildlife viewing, inspiration (spiritual and existence values), solitude, access to traditional sacred sites, and cultural/heritage values.

The Forest has been the site of cultural traditions for thousands of years, and its landscapes serve as a reminder of traditions shared across generations. Contemporary uses of resources and places are critical to maintaining the cultural identity of the San Luis Valley communities. Given the broad range of uses, it is not surprising that forest beneficiaries commonly hold conflicting values and understandings of how the Forest should be managed. While nearly half of Americans believe more public lands should be designated as wilderness, the remainder believe the current amount of wilderness is either sufficient or too much (Scott et al. 2003). While some people enjoy motorized recreation opportunities, others value more primitive forest experiences, while others may feel there are areas on the Forest that should be set aside for traditional uses and celebrations (sacred sites).

In the following section, the benefits the Forest provides to local beneficiaries and the general public in terms of opportunities to express traditional, cultural, and spiritual values are discussed. For more detailed information on traditional, cultural, and spiritual values, please see the *Cultural Resources, Sustainable Recreation,* and *Wilderness* sections.

The Forest contains many historic and cultural sites that are valued by local communities, tribes, and the general public. The Forest is generally perceived as an important part of the culture and heritage of San Luis Valley communities and attributed with protecting a number of sites of cultural and historic importance. Many stakeholders believe that management of these sites by the Forest Service increases public awareness of and access to opportunities to learn and interpret their cultural and historic significance. By preserving and facilitating the interpretation of these resources, the Forest provides cultural legacy and heritage values and ensures that these values will be passed on to present and future generations. The existence of these sites, as well as the ability to access these sites, increases the quality of life of those of who value them.

In addition to specific cultural sites, ecosystem integrity also contributes to the sustainability of tribal belief systems. These belief systems, including traditional ecological knowledge, are inextricably linked to ecosystem health and resilience (Climate and Traditional Knowledges Workgroup 2014).

A piece of the outdoor recreation/tourism economic contribution to the local economy can be found in the “heritage and cultural tourism” component of economic activity. The National Trust for Historic Preservation in the United States defines heritage tourism as "traveling to experience the places, artifacts, and activities that authentically represent the stories and people of the past," and "heritage tourism can include cultural, historic, and natural resources."

The industry today encompasses cultural and heritage specialists, who are an important resource for the travel and tourism industry in providing visitors with accurate and insightful interpretation of local resources. Communities, cultural and heritage organizations—such as museums, performing arts organizations, festivals, humanities, and historic preservation groups—have formed partnerships with tour operators, state travel offices, convention and visitors bureaus, hotels, and others to create initiatives that bring visitors to areas.

An integral but generally invisible component of the cultural and heritage sector are the artists, performers, writers, and other creative workers whose skills and vision bring to life the local area’s genius and ideas. These living traditions are generally supported by the cultural and heritage tourism infrastructure of institutions, galleries, performance spaces, and other community venues that make an important contribution to economic and community development. The arts, humanities, and heritage involve and benefit local residents in developing the narrative that creates a sense of place, which the travel and tourism industry can promote, market, and brand. Cultural and heritage tourism also provides a means of preserving and perpetuating the local area's cultural heritage through education, increased revenues and audiences, and good stewardship (Department of Commerce et al. 2005).

For more details on the cultural and historic uses, see the *Cultural Resources* section.

Solitude, Spirituality, and Sense of Escape

The opportunity to experience solitude or a spiritual connection to nature is another benefit the Forest provides. These inspirational benefits enhance the quality of life of those who hold these values. Both local community members and the general public enjoy these benefits. People can be inspired by, and connect with, nature in all recreation opportunity spectrum classes (see the *Sustainable Recreation* section for a description of recreation opportunity spectrum). For some user groups, such as backpackers and backcountry skiers, primitive and semiprimitive nonmotorized settings provide the most inspirational opportunities associated with solitude. For motorized and mechanized recreation users, roaded natural and rural settings provide the most inspiration or opportunities to connect with nature through various activities such as snowmobiling, downhill skiing, and camping in developed campgrounds. For others, simply knowing that wild lands (such as wilderness), wildlife (such as black bear and lynx), and wild, scenic, and recreational rivers exist in the Forest is a benefit, even if they never plan to visit. Native American tribes in the region hold particularly strong existence values around Blanca Peak. The existence of these lands and species, in and of themselves, serves as an inspiration, and enhances their quality of life (Watson et. al. 2015). For others, opportunities to experience solitude, particularly in wilderness areas, is seen as a benefit (McKenna et al. 2015). For some, they may come to the area and not actually visit the forest, but still search for solitude and an experience of inspiration, as seen from the many retreat centers in and around Crestone, which abuts the Forest.

Enterprises such as outfitters and guides, retreat/meditation centers, and other types of commercial enterprises take advantage of the unique character, including solitude, on the Forest and are marketing their specific trip or experience to those people who value solitude and/or spirituality.

For more details on specific areas where visitors may experience inspiration through solitude or spiritual connection to nature on the Forest, please see the *Sustainable Recreation, Wilderness,* and *Wild, Scenic, and Recreational Rivers* sections. For more details on species, see the *Wildlife and Plant Species* section.

Timber (Including Non-Timber Forest Products)

Timber harvests, including salvage and restoration activities such as thinning, provide forest products and contribute to the local economy, in addition to being an important tool in shaping the structure and composition of the forest. On average, more than 9,000 CCF of sawtimber were cut each year during the past decade. Over the last 5 years, however, the annual average cut volume for sawtimber was 12,410 CCF, with a high of 18,190 CCF for 2016 (Table 101).

Table 101. Commercial and noncommercial forest products: Volume and quantity, FY 2006–2016

[Source: USFS Forest Products Cut and Sold from the National Forests and Grasslands, 2006–2016. CCF, one hundred cubic feet.]

Year	Sawtimber (CCF)	Poles (CCF)	Firewood (CCF)	Miscellaneous and non-sawtimber products (CCF)
2006	6,949	704	5,274	66
2007	2,550	268	2,471	61
2008	3,680	620	3,108	456
2009	9,369	284	7,284	1,999
2010	9,811	88	6,908	523
2011	7,946	164	6,603	2,084
2012	7,930	440	6,342	706
2013	10,057	98	6,762	36
2014	8,019	0	7,729	609
2015	17,854	0	6,827	215
2016	18,190	0	8,637	1,081

Note that actual harvests are generally less than the estimated advertised or sold volume. While timber products are reported in both cut and sold volume, Forest Service economic impact analyses (using input-output models) on timber output generally rely on cut as opposed to sold volume. Because input-output models represent an annual snapshot of the area's economy, it is important to appropriately reflect the annual quantity of timber received and processed by commercial forest product firms during the same time horizon. Volume sold during a given year typically do not get harvested and converted into commercial products during the year of the sale due to various reasons including delays, canceled sales, sales overrun, as well as those sold but yet-to-be cut timber burned by wildfire. For information on sold volumes, see Rio Grande Assessment 8 and the *Forest Products* section.

Timber harvest directly supports employment and income in logging and wood manufacturing firms and also indirectly contributes to a number of other industries, from transportation and local government to other support sectors in the local economy. Based on average cut volumes in recent years (2012–2016), commercial timber harvests support a total of 174 full and part-time jobs, approximately $6.2 million in labor income, and $8.7 million in GDP contributions within the area of influence. About 110 (or 63 percent) of these jobs and $3.8 million (or 62 percent) of labor income are supported in the agriculture and manufacturing sectors. These sectors include firms that specialize in forestry and logging and forest product processing, which are key sectors of the study area.

Market and Timber Processing Capacity

Counties containing mills receiving Forest timber were identified in order to determine the timber-processing area for the Forest. This area includes 13 counties: Archuleta, Conejos, Costilla, Custer, Fremont, Hinsdale, Mineral, Montrose, Pueblo, Rio Grande, and Saguache Counties in Colorado and the northern portions of Rio Arriba and Taos Counties in New Mexico. A new mill in Costilla County (currently utilizing timber from within their own property) was also included due to its potential to utilize timber from the Forest in the future. Within the Forest timber-processing area there were 21 facilities operating as of 2016: 14 sawmills, and 6 log home and 1 viga manufacturer; five of the twelve sawmills reported producing substantial volumes of secondary products such as posts and poles or house logs. In addition, there was one sawmill, one co-located sawmill and post and pole plant, and one log furniture manufacturer that were idle during that year (Table 102). About 75 percent of the timber received by mills in the timber-processing area originated from national forests, of which 13 percent came from the Rio Grande National Forest. Of the 25 facilities in the Forest's timber-processing area, 16 relied on federal timber for more than 50 percent of their inputs (McIver et al. 2017).

Table 102. Active facilities in the timber processing area of the Forest

[Source: McIver et al. (2017)]

Type	2003	2007	2012	2016
Sawmills	22	13	13	14
Log Home	15	6	5	6
Log Furniture	3	2	0	0
Vigas and latillas	3	1	1	1
Post and Pole	2	1	0	0
Total	45	23	19	21

Timber Processing Capacity and Use by Size Class

Factors influencing the trend and sustainability of the Forest's contribution include varying budget level for timber management and sales administration, as well as the housing market, which also fluctuates in cycles. One of the major risks and drivers affecting the continued provision of the Forest's commercial timber supply is the large amount of Engelmann spruce mortality from spruce beetle. Although efforts have been underway to increase the harvest of these trees in recent years, the harvest is sustainable only in the near short to medium term because the larger—and financially viable—dead trees cannot retain their value as saw or house logs indefinitely. The market for lower quality woody biomass such as decayed dead timber is difficult (Forest Stewardship Concepts, Ltd. 2014).

However, trends in these changing forest conditions indicate that it is increasingly critical for markets to expand, in order to accommodate for small-diameter material and salvaged timber. Capacity utilization at sawmills and other timber-using facilities in the Western United States fell from more than 80 percent in 2005 to just more than 50 percent in 2009 and 2010 (Keegan et al. 2011). From 2003 to 2012, capacity to process timber in the Rio Grande Timber Processing Area decreased from 84.0 MMBF to 69.3 MMBF, but had rebounded to 80.4 with the opening of two new mills in the region. Excluding the two new mills that came online at the end of 2016, mills were operating at about 58 percent of capacity in 2016. As much as 12 percent (2,080 MCF) of the 17,722 MCF of existing capacity was capable of processing trees less than 10 inches diameter at breast height, with as much as 69 percent of that capacity used. However, as a proportion of total timber processed, trees less than 10 inches diameter at breast height accounted for 15 percent of total timber processed in 2016 (Table 103).

Table 103. Annual capacity and capability to process trees by size class in the timber processing area of the Forest, 2016

[Source: McIver et al. (2017); DBH, diameter at breast height; MCF, thousand cubic feet.]

Tree DBH	Capability	Use	Capacity Utilized
	MCF		Percent
Less than 10 inches	2,080	1,431	69
10 inches and over	15,642	7,877	50
Total Capacity	17,722	9,308	53

An additional 294 MCF of capacity existed among inactive facilities, of which 100 MCF was estimated to be capable of processing trees less than 10 inches diameter at breast height, should they come back online. Overall capacity utilization was low due in part to the inclusion of two new mills that opened in late 2016 but did not report any utilization for the year (McIver et al. 2017).

The loss of milling infrastructure throughout the West and in Colorado raises questions about the industry's capability to process trees of various sizes (Keegan et al. 2005, 2006). Other than the challenge of adapting to a changed forest landscape (resulting to the shift away from traditional logging and toward service-type projects, such as those resulting in smaller diameter timber), there exists various issues facing forestry firms in Colorado. Challenges facing contractors include a shrunken workforce, fewer federal timber sales, competition with local fire districts, landowners' understanding about the expense of mitigation work, and competition with illegitimate contractors (Vaughan and Mackes 2014).

Non-timber Forest Products

Non-timber forest products (Table 104) are products or natural resources that are not the traditional timber and fiber products. They are also known as special forest products or non-convertible products because they are products that are not converted into board foot or cubic foot measure. Examples include such products as floral greenery, Christmas trees and boughs, mushrooms, transplants (trees, shrubs or herbaceous plants), cones, medicinal plants, cuttings, herbs, nuts, berries, decorative wood, and pitch. In recent years the Forest sold about $8,500 worth of special forest products annually. These include Christmas trees, transplants, limbs/boughs, cones, and seeds.

Table 104. Special forest products harvest (cut) quantity and value, FY 2012–2016

[Source: USFS Forest Products Cut and Sold from the National Forests and Grasslands (USDA Forest Service 2012–2016); --, no data]

	2012	2013	2014	2015	2016
Christmas Trees – each	902	983	819	899	926
Cut Value ($)	$7,216	$7,864	$6,552	$7,192	$7,408
Transplant – each	211	189	192	202	273
Cut Value ($)	$1,055	$945	$690	$1,000	$1,365
Limb/Bough – each	--	--	2	12	2
Cut Value ($)	--	--	$20	$120	$20
Cones – Dry – per bushel	100	--	--	200	200
Cut Value ($)	$300	--	--	$300	$300
Seed – per pound	300	--	--	800	--
Cut Value ($)	$60	--	--	$200	--

Although only Christmas trees, transplants, limbs/boughs, cones, and seeds have been recorded in the official Cut and Sold report, a variety of other non-timber forest products are enjoyed by both locals and visitors alike. Some of these examples and uses are listed in Table 105.

Water Resources

A well-functioning ecosystem helps maintain the integrity of the watersheds so that upland forests, riparian areas, and wetlands are able to filter out pollutants to help keep base loads within reasonable levels, which reduces municipal and well-water treatment costs and alleviates demand for costly infrastructure. The concept of water supply deals mostly with quantity. But water quality and timing of water availability are two equally important issues surrounding water resources management. Quality water in predictable quantity is one of the major ecosystem benefits provided by intact forest ecosystems. See Assessment 2 – Air, Soil, and Water (USDA Forest Service 2016) for detail regarding the existing condition on watersheds and water resources, particularly information regarding water rights, municipal watersheds, and watershed condition framework.

This section focuses on the provisioning service of water supply originating from the Forest in terms of water quantity, flow, and water demand in the analysis area. In other words, this section addresses three questions: (1) how much water originates at the Forest boundary, (2) where does it all go, and (3) how much water is demanded downstream in the area of influence.

Table 105. Definition and example uses of special forest products

Product	Definition and Example Uses
Transplants[1] (Wildlings)	Young wild or natural seedling use in landscaping
Limbs and Boughs[1]	The limbs and boughs of trees used in making decorations
Foliage	The foliage of a variety of shrubs used in making decorations
Needles	Needles of conifers used in making decorations and baskets
Bark[1]	Bark from a variety of trees and shrubs used in landscaping and making decorations
Cones, Green	Cones used for seed and in making decorations
Cones, Dry	Cones used landscaping and in making decorations
Seed	Seed of any plant or shrub specie that is used for sowing or seeding to grow new plants
Nuts and Seed	Nuts and seed used for food
Fruits and Berries	Fruits and berries used for food
Roots	Roots use for pitch and tar, also roots use in the creation of novelty items
Bulbs	Bulbs of plants used for transplanting
Mushrooms	A variety of mushroom species used for food
Fungi	A variety of fungi used for decorations
Mosses	A variety of fungi used for decorations
Herbs	A variety of herbs used for medicinal purpose
Ferns	A variety of ferns used for decorations
Wildflowers	A variety of wildflowers used for decorations
Grass	A variety of grasses used for decorations
Aquatic Plants	A variety of aquatic plants used for landscaping
Cacti	A variety of cacti used for landscaping and decorations
Green Biomass NCV[1]	Green Biomass (wood fiber) - Non-convertible to MBF or CCF used as fuel

[1] Commercial permits may be required.

Mean Annual Water Supply

Forested landscapes and headwater locales tend to receive more precipitation than adjacent nonforested or low-lying areas. Accounting for the differences in evapotranspiration across land cover types is necessary in order to estimate the volume of water supply originating from any given landscape. By using a Variable Infiltration Capacity model, contribution to water supply from the Forest was estimated at 465.4 billion gallons on an annual average basis (Brown et al. 2016).

Contributions to Regional Streamflow Volumes

Water originating from the Forest flows downstream and joins several creeks, rivers, and other waterbodies within the watershed. Based on hydrologic model data on daily runoff and base flow (Livneh et al. 2013), contributions from the Forest's water supply to regional streamflow volumes was estimated (Luce 2016). In an average year, the Forest contributes 84 percent of the water in the Rio Grande Headwaters hydrologic unit (HUC 1301), while the unit occupies only 39 percent of the land area within this 4-digit HUC. The percentage of streamflow the Forest contributes to each 8-digit HUC and to major streamflow points is shown in Table 106.

Table 106. Forest contributions to streamflow and hydrologic units

[Source: Luce (2016). HUC, Hydrologic Unit Code]

Contribution (percent)	Streamflow location and water contribution
100	Flow at Red Mountain Creek (at the confluence with Rio Grande)
78	Flow at Conejos River at the Conejos hydrologic unit (HUC 13010005)
91	Flow at the Saguache Creek at the San Luis hydrologic unit (HUC 13010003)
99	Water in Rio Grande Headwaters hydrologic unit (HUC 13010001)
51	Water in Alamosa-Trinchera hydrologic unit (HUC 13010002)
67	Water in San Luis hydrologic unit (HUC 13010003)
90	Water in Saguache hydrologic unit (HUC 13010004)
78	Water in Conejos hydrologic unit (HUC 13010005)
6	Water in Rio Chama hydrologic unit (HUC 13020102)

It is clear that the unit contributes a majority of water supply and streamflow in some areas. For example, the Forest contributes 100 percent of the flow at Red Mountain Creek at the confluence with Rio Grande, and 90 percent of the water in the Saguache hydrologic unit (HUC 13010004).

Water Uses in the Area of Influence

Since 1950, the U.S. Geological Survey has collected and published estimates of water withdrawals by water-use category at the national, state, and county level every 5 years. Although water originating from the Forest contributes to streamflow extending into central New Mexico, information on water use is reported below only for those counties within the broader economic zone of influence. Note that some counties within the study area, including Gunnison and Montrose, are outside of the watersheds that the Forest contributes to; therefore, information is presented for those counties for comparison purposes. Residents within the seven-county San Luis Valley area are served by groundwater for public water supply. Conejos County uses the most water for pubic supply (2.3 Mgal/d), serving more than 4,700 people. For comparison, residents in Alamosa County served by public water supply (more than 9,000 people) withdraw about 1.7 Mgal/d (Maupin et al. 2014) (Table 107). Water originating from the Forest contributes to groundwater supply in the area, but the time horizon for recharge is long.

Table 107. Public water supply and population served, 2010

[Source: Maupin et al. (2014). Bolded counties are in the San Luis Valley area of influence. Mgal/d, million gallons per day]

COUNTY	Public Supply, population served by groundwater, in thousands	Public Supply, population served by surface water, in thousands	Public Supply, total population served, in thousands	Public Supply, groundwater withdrawals, total, in Mgal/d	Public Supply, surface-water withdrawals, total, in Mgal/d	Public Supply, total withdrawals, in Mgal/d
Alamosa	**9.0**	**0.0**	**9.0**	**1.7**	**0.0**	**1.7**
Archuleta	1.5	6.1	7.7	0.1	1.9	2.0
Conejos	**4.7**	**0.0**	**4.7**	**2.3**	**0.0**	**2.3**
Costilla	**2.2**	**0.0**	**2.2**	**0.4**	**0.0**	**0.4**
Custer	2.0	0.0	2.0	0.2	0.0	0.2
Fremont	0.0	39.5	39.5	0.0	8.9	8.9
Gunnison	10.2	3.7	13.9	1.7	0.8	2.5
Hinsdale	**0.4**	**0.0**	**0.4**	**0.6**	**0.0**	**0.6**
La Plata	11.6	33.9	45.5	1.1	6.6	7.7
Mineral	**0.6**	**0.0**	**0.6**	**0.2**	**0.0**	**0.2**
Montrose	0.9	36.7	37.6	0.2	9.3	9.6
Rio Arriba, NM			24.0	1.6	0.6	2.3
Rio Grande	**6.9**	**0.0**	**6.9**	**1.1**	**0.0**	**1.1**
Saguache	**4.6**	**0.0**	**4.6**	**0.9**	**0.0**	**0.9**
San Juan	0.0	0.6	0.6	0.0	0.2	0.2
Taos, NM			20.2	1.9	0.2	2.0
Area Total	**54.6**	**120.6**	**219.3**	**14.0**	**28.5**	**42.5**

Water use by category, including irrigation, livestock, aquaculture, mining, thermoelectric, and self-supplied for domestic or industrial uses, is shown in Table 108. At 579 Mgal/d, Rio Grande County used the most water, almost all for irrigation. All other counties within the San Luis Valley area also used most of their water for irrigation. Outside of the area, San Juan County used the majority of its water for aquaculture.

Table 108. Total water withdrawals by water-use category, 2010

[Source: Maupin et al. (2014). Reported in million gallons per day. Bolded counties are in the San Luis Valley area of influence.]

County	Public Supply	Self-supplied domestic	Industrial, self-supplied	Irrigation	Livestock	Aquaculture	Mining	Thermoelectric	Total
Alamosa	**1.7**	**0.9**	**0.0**	**149.4**	**0.2**	**0.3**	**0.0**	**0.0**	**152.4**
Archuleta	2.0	1.1	0.0	56.0	0.1	0.0	0.1	0.0	59.3
Conejos	**2.3**	**1.0**	**0.0**	**366.5**	**0.4**	**12.3**	**0.0**	**0.0**	**382.5**
Costilla	**0.4**	**0.2**	**0.0**	**135.2**	**0.1**	**4.0**	**0.0**	**0.0**	**139.9**
Custer	0.2	0.2	0.0	26.8	0.1	0.0	0.0	0.0	27.2
Fremont	8.9	0.7	5.5	116.9	0.3	0.0	0.4	13.7	146.2
Gunnison	2.5	0.1	0.0	553.3	0.2	6.0	0.6	0.0	562.7
Hinsdale	**0.6**	**0.1**	**0.0**	**27.0**	**0.0**	**2.7**	**0.0**	**0.0**	**30.4**
La Plata	7.7	0.6	0.2	321.2	0.3	5.8	0.8	0.0	336.6
Mineral	**0.2**	**0.0**	**0.0**	**15.6**	**0.0**	**2.7**	**0.0**	**0.0**	**18.5**
Montrose	9.6	0.7	0.0	690.3	0.7	0.0	0.1	1.6	702.9
Rio Arriba, NM	2.3	1.3	0.0	101.7	0.4	1.0	0.5	0.0	107.1
Rio Grande	**1.1**	**0.6**	**0.0**	**577.2**	**0.2**	**0.0**	**0.1**	**0.0**	**579.2**
Saguache	**0.9**	**0.2**	**0.0**	**269.5**	**0.3**	**0.0**	**0.1**	**0.0**	**270.9**
San Juan	0.2	0.0	0.0	0.0	0.0	1.3	0.0	0.0	1.6
Taos, NM	2.0	1.0	0.0	82.4	0.1	10.9	10.1	0.0	106.5
Area Total	**42.5**	**8.8**	**5.7**	**3,488.8**	**3.2**	**46.9**	**12.8**	**15.3**	**3,623.9**

Ecosystem Services in Connection with Fish, Wildlife, and Plant Species

Species supported by habitats on the Forest are enjoyed—both consumptively and non-consumptively—by local and nonlocal residents alike. Also, various threatened and endangered species, along with other species of conservation concern, are known to occur within the Forest. This section provides a brief overview on the diverse types of uses and benefits that people derive from wildlife resources. See the *Aquatic Ecosystems* section and the *Wildlife and Plants Species* section for more information on the existing conditions for those species.

Consumptive uses of wildlife resources include hunting, fishing, and commercial trapping, while **non-consumptive uses** include wildlife viewing, photography, nature study, etc. About 35 percent of Forest visitors participate in wildlife viewing, while 17 and 12 percent of the visitors participate in fishing and hunting activities, respectively. Regional economic effects (in terms of employment, income, and GDP contributions) from these activities are shown above.

There are also other **passive use values** associated with the enjoyment of fish, wildlife, and plant species; these include existence, option, and bequest values.

Existence values are benefits people derive from the very existence of species, even when an individual has not ever seen, or planned on ever seeing, the species on the Forest. For example, some local residents and nonlocal visitors are willing to pay for the preservation of wildlife through donations and/or taxes, even if they know that they may never actually encounter some particular species. Some segments of the public may also have a general appreciation for biodiversity and for the many ecosystem services that nature provides. **Vicarious use value** is closely related to existence values. Vicarious use value occurs when people gain pleasure from pictures, broadcasts, or written accounts of nature, including plants and wildlife species on the Forest. Another form of existence value is **intrinsic value**. Wildlife has a right to exist, and therefore, has value independent of any human involvement. Intrinsic value is the human perception of that value.

Option values exist when people are conscious that they might want to enjoy (either consumptively or non-consumptively) some species of fish, plant, or wildlife on the Forest in the future, but are unsure that it will be available at that time, and they may be willing to pay a premium to ensure its future availability. **Quasi-option value**, on the other hand, is the potential benefits of new—or yet-to-be discovered—species and uses of plants and wildlife for a variety of benefits, including medicinal, agricultural, and other uses. This is based on the fear that any further destruction of habitats and species on the Forest may obliterate future opportunities for beneficial discoveries. Lastly, there are **bequest values**, where individuals attach value from the fact that plant, fish, and wildlife species on the Forest will be available for the enjoyment of future generations.

Passive-use values are not limited to the discussion of wildlife and plant species; other resources also share these components, from wilderness, cultural, water, scenic and other natural resources.

Infrastructure and Agency Operation

Infrastructure within the plan area can have substantial contributions to social and economic sustainability. These can include facilities for energy generation or transport, communications, water delivery, transportation (including airstrips and other aviation testing sites), or recreation. These facilities directly affect conditions and uses within the plan area and may support delivery of goods and services in the broader landscape. Infrastructure on the Forest can contribute to the social, economic, and cultural conditions within the Forest boundaries, and also within the broader social and economic area of influence. Infrastructure can directly support the delivery of goods and services; as such, their conditions can be a vital piece of the local economy.

Infrastructure within the Forest includes:

- 2,260 miles of roads
- 1,298 miles of trails
- Three active utility corridors
- Buildings and facilities including office space, barracks, and communication systems.
- Bridges, dams, water systems, and wastewater systems.
- Two priority watersheds
- Dams and irrigation systems that operate by special use permit
- Communication sites.

Due to budgetary limitations, numerous infrastructure resources have had necessary maintenance deferred. A number have been listed as health and safety critical, including roads, dams, water systems, wastewater systems, facilities, and bridges. Deferred maintenance backlog is not sustainable. If not funded, numerous locations will need to be closed, which has the potential to limit access, reduce water quality, and increase demand on other infrastructure and recreation facilities. See the Assessment 11 and the *Infrastructure, Roads, and Facilities* section as well as the *Sustainable Recreation Opportunities* section.

Forest Service Presence in the Community

Management of the Forest directly contributes to the local economy by employing individuals living within the area and by spending federally appropriated dollars on goods and services to carry out management programs. From 2011 to 2016, expenditures on Forest programs and salary for personnel on the Forest have averaged $12 million a year ($6.3 million on salary expenditures and $5.7 million on non-salary expenditures) (K. Pacheco, Rio Grande Budget Officer, 2017). Program-related expenditures do not include spending on emergency fire suppression activities. Spending on fire suppression varies from year to year; however, spending on these activities has the potential to have a positive impact on local economies.

On an average annual basis, expenditures associated with the management of the Forest support 232 jobs (direct, indirect, and induced) and about $10 million in local labor income in the social and economic area of influence surrounding the Forest (IMPLAN 2014). These values are the result of Forest Service spending on restoration activities, local lodging for Forest Service personnel, filling Forest Service vehicles at local gas stations, hiring local contractors for building maintenance, etc. The impact of a local area or community losing a Forest Service office is much like the closure of a military base, but at a smaller scale in more rural areas.

Forest Service staffs, partnerships, contracts, or agreements with the Forest Service, as well as other operations, directly and indirectly influence the social, cultural, and economic conditions of the affected communities through demand for local goods and services, contributions to the tax base, and participation in community institutions and activities. While plans do not include staffing and procurement strategies, the presence and impact of Agency resources in the area of influence are considered in this analysis. Annual employment by the Forest has supported an average of 80 permanent employees and 36 temporary employees from 2011 through 2016 (T. Ghormley, Rio Grande Administrative Officer, personal communication, 2017).

Forest Service employees also engage in their local communities on a more social level with many employees involved as youth sports coaches, nonprofit board volunteers, and school board volunteers; in addition, many are active in the planning of local charity events, participate in local events, are active in neighborhood events, and generally care about the quality of life and conditions of and in their community. When an individual employee leaves for a new job in a different area, or retires to a different area, it can leave a hole in a community that eventually is filled by a current resident, or by a new employee coming into the community. But if an entire unit moves or staff of a unit is substantially reduced due to budget constraints, a community may take time to recover from losing a large portion of its volunteer structure.

Federal Payments

Another economic relation between federal land and county economies are federal revenue sharing and land payments including SRS and PILT. State and local government cannot tax federally owned lands the way it would be taxed if the land were privately owned. A number of federal programs exist to compensate county governments for the presence of federal lands. These programs can represent an important portion of local government revenue in rural counties with large federal land holdings, such as a few of the counties in the San Luis Valley area of influence.

Before 1976, all federal payments were linked directly to receipts generated on public lands. Congress funded PILT with appropriations beginning in 1977 in recognition of the volatility and inadequacy of federal revenue sharing programs. PILT was intended to stabilize and increase federal land payments to county governments. More recently, the Secure Rural Schools and Community Self-Determination Act of 2000 decoupled Forest Service payments from commercial receipts. SRS received broad support because it addressed several major concerns around receipt-based programs: volatility, the payment level, and the incentives provided to counties by linking federal land payments directly to extractive uses of public lands.

As described in the *Economic Environment* section, federal payments to local counties were nearly $3.6 million in 2016. SRS payments accounted for $1.67 million and PILT payments accounted for $1.9 million. Combined, PILT and SRS payments supported 87 jobs and $3.6

million in labor income annually (IMPLAN 2014). These values will fluctuate annually based on future payment values.

If the SRS payments were no longer funded, then the federal payment system would revert back to the 25-percent fund. As described in the *Economic Environment* section, these payments are about 87 percent less and would total $217,000. In this case, only 54 jobs and $2.3 million in labor income would be supported annually (IMPLAN 2014). The loss of SRS payments would have a direct negative impact primarily in the agricultural and government sectors (IMPLAN 2014). Additionally, the social impacts would be widespread. SRS payments are heavily relied upon to fund rural schools; steep cuts to education would have both short and long-term impacts related to education, which would reduce the social and economic wellbeing of young residents.

Direct and Indirect Effects

Contribution to Social and Economic Sustainability

Forest plans under the 2012 Planning Rule recognized ecological, social, and economic systems as interdependent, without one being a priority over the other, and that they must have plan components to guide contribution to social and economic sustainability (36 CFR 219.8(b)). This analysis evaluates the proposed plan, and its alternatives, in terms of contributions to social and economic sustainability through the provisions of (1) multiple uses, (2) ecosystem services, (3) infrastructure, and (4) Forest Service presence in the community (FSH 1909.12, ch. 20, sec. 23.21 and FSH 1909.12, ch. 10, sec. 13).

Effects on Multiple Uses and Ecosystem Services from Management of Other Resources

The provision of multiple uses and ecosystem services are two of the major contributions to social and economic sustainability of the Forest in the broader landscape. Ecosystem services—components of nature that contribute to human well-being—and multiple uses are fully related and best analyzed in an integrated manner. Elements of multiple uses (outdoor recreation, range, timber, watershed, wildlife, and fish) and the set of key ecosystem services considered in the plan area are evaluated in this section on the various ways they contribute to people, communities, and ultimately social and economic sustainability. These elements include forage for grazing; outdoor recreation; mineral deposits; cultural, history, and scared sites; solitude, spirituality and sense of escape; timber and non-timber forest products; water resources; fish, wildlife, and plants (including pollination, support of habitat and species diversity, abundance, and distribution).

Forage for Grazing

Grazing opportunities are the same across alternatives B and C, and are identical to current conditions that permit 75,684 animal unit months of cattle and 8,238 animal unit months of sheep (J. Pérez, Rio Grande Range Specialist, 2017). Alternative D would reduce the ability to use motorized or mechanized travel in managing allotments. This would increase the cost of grazing to the permittee and decrease efficiency. It is difficult to monetarily quantify the increase in costs to permittees. Despite lost acreage to special interest areas, the number of animal unit months grazed under alternative D is not anticipated to be lower than for alternatives B or C.

If Forest acres available for grazing remain more or less constant, then, if and when private grazing lands become less and less available, the relative importance of grazing on public lands will increase. Reduction in private grazing opportunities would likely be caused by growing communities and urban areas. When the income-producing potential of development exceeds the income-producing potential of farming and ranching operations, land sales become an attractive source of income. This is particularly true for areas with a variety of amenities and those located near mountain resorts. However, this assumption assumes that ranchers are motivated strictly by profit maximization; in reality, they are not. Gentner and Tanaka (2002) found that federal public land permittees ranked lifestyle attributes above profit maximization. Family traditions, culture, and values are some of the more important reasons for maintaining ranching operations.

Grazing on Forest lands occurs primarily in Conejos, Hinsdale, Mineral, Rio Grande, and Saguache Counties. Additionally, permittees on the Forest either reside in, or businesses are based primarily out of, four counties in the San Luis Valley area of influence: Alamosa, Conejos, Rio Grande, and Saguache. These counties would absorb much of the direct economic activity from grazing on the Forest.

Presently, private agricultural and grazing land availability varies throughout the area of influence. Based on land surveys, Conejos County has 227,603 acres of agricultural land, 56 percent of which is suitable for grazing (Wildrose Appraisal Inc. 2014a). In Alamosa County there are 235,899 acres of agricultural land, 37 percent of which is suitable for grazing (Wildrose Appraisal Inc. 2015a). In Rio Grande County, there are 188,899 acres of agricultural lands, 18 percent of which are suitable for grazing (Wildrose Appraisal Inc. 2015b). In Saguache County, there are 502,525 acres of agricultural lands, 42 percent of which is suitable for grazing (Wildrose Appraisal Inc. 2014b). In 2016, the cost per animal unit month of private agricultural land was $17.50 in Colorado and the cost of public forage was $1.87 per animal unit month. Despite federal public grazing per animal unit month being substantially less expensive, grazing fees alone do not represent the total cost of grazing. Rimbley and Torrell (2011) found that the cost differential between public and private land grazing is less than indicated by the grazing fee disparity. Once other grazing-related costs (e.g., maintenance) are taken into account, the cost difference is eliminated. If a cost difference were to occur (i.e., if ranchers were to pay more to obtain private forage), the economic effect would be an income transfer from net consumers of forage to net providers of forage.

Grazing across all alternatives would support about 274 jobs and $6.2 million in labor income on an average annual basis. About 223 of these jobs and $3.5 million of local labor income are supported in the agriculture sector. As demonstrated by the *Economic Base Analysis* section, these activities are an important part of the San Luis Valley economy. Under alternative D, increased costs associated with motorized restrictions might financially impact some ranching operations, which could reduce the employment and income of grazing-related activities. Additionally, as previously discussed, ranching plays an important social role and is strongly tied to tradition and values, and is seen as a way of life. As such, restriction or potential reduction in grazing associated with alternative D may affect some ranchers' quality of life and livelihood, if the ranching operation could not accommodate and adapt to those restrictions, including subsequent range management stipulations when the plan is implemented.

Outdoor Recreation, Tourism, Landscapes, and Features Providing Recreation and Scenery

All alternatives will provide for dispersed outdoor recreational opportunities. Nonmotorized and nonmechanized dispersed recreational opportunities, such as hiking, pack-stock use, and tent camping, would continue throughout the Forest in all alternatives.

Wilderness stakeholders seeking solitude in the Forest are likely to prefer alternative D over alternatives B and C because it provides the greatest number of new recommended wilderness acres, removes motorized trails from Colorado roadless areas, establishes a federal trails corridor, and adds several special interest areas and an additional research natural area to the system. Alternative B would also provide recommended wilderness, but to a lesser degree. Assuming that solitude and protection of those values is most important to wilderness stakeholders, alternative C would not be preferred because it does not propose any specially designated areas.

A dispersed recreation stakeholder is most likely to prefer alternative C followed by B and then D. Alternative C provides the greatest variety of multiple use opportunities on the Forest due to its lack of recommended wilderness and the ability of the Forest to provide a greater potential of multi-use recreational access. Alternative D would decrease potential for multi-use recreational access by restricting motorized access within new recommended wilderness acres, as well as adding several special interest areas and an additional research natural area to the system. Alternative B does not propose adding several special interest areas and an additional research natural area to the system, but does propose wilderness areas. Alternatives B and D would also reduce mechanized dispersed recreation opportunities, such as mountain biking, when recommended wilderness areas are congressionally designated as wilderness study areas or wilderness areas.

Assuming the visitation rate of local residents will remain nearly constant and that new residents will visit the Forest at about the same rate as current residents, the Forest can expect to experience continued use by local visitors. The Forest can expect moderate increases in use as visitor populations associated with growing populations around the study area are likely to increase in the future (English et al. 2015). As increases in recreation visits and impacts on recreation resources and opportunities occur over time, pressure and conflicts may require additional monitoring and management.

Timber (Including Non-Timber Forest Products)

Under all of the alternatives, the Forest will continue to provide opportunities for non-timber forest product utilization. Commercial timber harvest opportunities vary by alternative, with the most harvest under alternative C and the least under alternative D.

Harvest and processing of commercial forest products, including salvage materials, not only supports employment and income in the logging and wood manufacturing industries (direct effect) but also ultimately contributes to a number of other firms, from transportation and local government to other support sectors in the local economy (indirect and induced effects). An economic contribution analysis (input-output model using IMPLAN) was conducted to estimate the direct, indirect, and induced effects of stumpage flowing through logging companies, sawmills, and other related firms such as post and pole operations. Economic contributions from projected timber sale and wood sale quantities, based on annual average volume (including sawtimber, other products, fuelwood, and salvage) for each alternative, are estimated with IMPLAN and shown in Table 109.

Table 109. Annual average economic contributions (jobs, income, and GDP) based on total projected timber sale and wood sale quantities, including salvage volume, by alternative

	Alts A and B (1st Decade)	Alts A and B (2nd Decade)	Alt C (years 1 - 6)	Alt C (Year 7 through 2nd Decade)	Alts D (1st Decade)	Alts D (2nd Decade)
Total volume including Salvage (CCF)	40,000	15,600	70,000	22,200	25,000	11,200
Salvage-only (CCF)	32,100	0	62,800	0	17,300	0
Employment						
Direct	240	55	461	98	130	26
Indirect and Induced	205	45	394	80	111	21
Total	445	100	855	178	242	47
Labor Income (thousands of 2014$)						
Direct	$8,549	$1,984	$16,402	$3,544	$4,636	$945
Indirect and Induced	$7,229	$1,623	$13,878	$2,898	$3,920	$773
Total	$15,778	$3,608	$30,280	$6,442	$8,556	$1,718
GDP (thousands of 2014$)						
Direct	$10,458	$2,303	$20,085	$4,113	$5,670	$1,097
Indirect and Induced	$12,051	$2,416	$23,184	$4,314	$6,530	$1,150
Total	$22,510	$4,719	$43,269	$8,427	$12,201	$2,247

Based on the total estimated projected wood and timber sale quantities for alternatives A and B, as well as estimated salvage volume (40,000 CCF), timber harvests support more than 400 full- and part-time jobs, about $15 million in labor income, and $22.5 million in GDP contribution across the area of influence on an annual average basis during the first decade. During the second decade, without any salvage volume, timber harvests support about 100 full- and part-time jobs, approximately $3.6 million in labor income and $4.7 million in GDP contribution across the area of influence on an annual average basis. These results are the total direct, indirect, and induced effects across all industries within the broader social and economic area of influence. All direct jobs, labor income, and GDP are supported in the agriculture and manufacturing industries—which include firms specializing in forestry and logging and forest product processing. Indirect and induced effects occur throughout the regional economy among a dozen other industries, especially those in accommodation and food services; health care and social assistance; administration; waste and remediation services; professional, scientific, and technical services; and wholesale trade. These represent the ripple effects that local forestry firms have on other sectors in the greater economy. See

Table 110 and Table 111, located at the end of this *Contributions to Social and Economic Sustainability* section, for complete results by individual industries.

Based on the total estimated projected wood and timber sale quantities for alternative C, as well as estimated salvage volume (70,000 CCF) during the first 6 years, timber harvests support more than 800 full- and part-time jobs, about $30 million in labor income, and $43 million in GDP contribution across the area of influence on an annual average basis. From year 7 through the second decade, without any salvage volume, timber harvests support fewer than 200 full- and part-time jobs, approximately $6.4 million in labor income, and $8.4 million in GDP contribution across the area of influence on an annual average basis. All direct jobs, labor income, and GDP are supported in the agriculture and manufacturing industries, while indirect and induced effects occur throughout the regional economy, especially those in the accommodation and food services; health care and social assistance; administration; waste and remediation services; professional, scientific, and technical services; and wholesale trade. These represent the ripple effects that local forestry firms have on other sectors in the greater economy. See Table 112 and Table 113, located at the end of this *Contributions to Social and Economic Sustainability* section, for complete results by individual industries.

Based on the total estimated projected wood and timber sale quantities for alternative D as well as estimated salvage volume (25,000 CCF), timber harvests support more than 200 full- and part-time jobs, about $8.5 million in labor income, and $12 million in GDP contribution across the area of influence on an annual average basis during the first decade. During the second decade, without any salvage volume, timber harvests support fewer than 50 full- and part-time jobs, approximately $1.7 million in labor income, and $2.2 million in GDP contribution across the area of influence on an annual average basis. All direct jobs, labor income, and GDP are supported in the agriculture and manufacturing sectors. See Table 114 and Table 115, located at the end of this *Contributions to Social and Economic Sustainability* section, for complete results by individual industries, including those indirect and induced effects.

It should be noted that employment effects are expressed on an annual average basis—a standard convention that is consistent with methods used by the U.S. Bureau of Labor Statistics. When jobs are counted this way, one cannot discern from the data the number of hours worked or the proportion that are full- or part-time or anything about seasonality; only that they are yearlong. These jobs are different than full-time equivalent jobs. These results are the direct, indirect, and induced, and total estimates for full- and part-time employment and labor income that may be attributed to different alternatives. It is important to note that these may not be new jobs or income, but rather existing jobs and income in the regional economy that are supported or sustained on an annual average basis.

Estimates of employment, income, and GDP effects as shown in Table 109 are heavily dependent upon the duration of implementation of timber sales. If the actual implementation period is shorter than shown, estimated effects may be more concentrated over a shorter period of time. Conversely, if the implementation period is expanded, fewer jobs would be supported annually, but for a longer period of time. Also, within the implementation period, the numbers of jobs supported may or may not be filled by the same personnel nor distributed evenly over time, depending upon the nature of the sales, turnovers, number and type of firms involved, and other factors. Therefore, it is misleading—or, meaningless at best—to try to calculate a total figure for the life of the plan. To be precise, it would be a reckless exercise to multiply the annual average employment as presented above, with the implementation timeframe (or life of the plan) in an attempt to arrive at a 'grand total.'

Also note that salvage volume made up the majority of projected harvest during the first decade and none during the second decade (See *Diversity of Vegetation* section for details). The size class of salvage timber may be one of the most important factors determining whether the industry could benefit from these estimated volume. As such, all estimated employment and income contributions shown above are contingent upon the industry's ability to process various timber products, including smaller diameter salvage volume, especially during the initial years. As previously discussed in the *Affected Environment* section, as much as 12 percent (2,080 MCF) of the 17,722 MCF of existing capacity was capable of processing trees <10 inches dbh, with as much as 69 percent of that capacity utilized. As a proportion of their total timber processed, trees <10 inches dbh accounted for 15 percent of total timber use in 2016 (Table 103). An additional 294 MCF of capacity existed among inactive facilities, of which 100 MCF was estimated to be capable of processing trees <10 inches dbh, should they come back online. Overall, mills capacity utilization was low due in part to the inclusion of two new mills that opened in late 2016 but did not report any utilization for the year (McIver et al. 2017). However, after excluding the two new mills that came online at the end of 2016, mills utilized about 58 percent of their capacity in 2016.

The loss of milling infrastructure throughout the West and in Colorado raises questions about the industry's capability to process trees of various sizes (Keegan et al. 2005, 2006). Other than the challenge of adapting to a changed forest landscape (resulting in the shift away from traditional logging and toward service-type projects, such as those resulting in smaller diameter timber), various issues face forestry firms in Colorado. Recent survey results indicate that a diminished forestry workforce and contractor capacity means that Colorado will face substantial challenge to mitigate various restoration needs to address forest health and prevent catastrophic wildfires (Vaughan and Mackes 2014).

Water Resources

None of the alternatives are expected to impact the municipal supply watersheds and irrigation deliveries. Therefore, downstream impacts from alternatives A through D relative to quantity, quality, availability, and existing water rights are not anticipated to be any different from current conditions.

Under alternatives B through D, water resources will be impacted primarily from roads and trails, timber harvesting, and livestock grazing.

Livestock grazing is identical across all alternatives; however, plan components similar across all alternatives emphasize the health of water resources. As a result, alternatives B through D offer greater protection of water resources from livestock grazing.

Potential road and trail maintenance expansion would likely be most connected to the suitable timber base acres; therefore, alternative C would likely have the greatest watershed impacts and alternative D would likely have the fewest impacts to watershed resources. Alternative A would likely have fewer watershed impacts than alternative B due to fewer designated acres as suitable timber base.

Details about the various effects on watershed resources from climate change, mineral extraction, designated areas, fire, and other management approaches are described in the *Watershed Resources* section.

Ecosystem Services in Connection with Fish, Wildlife, and Plant Species

Under all the alternatives, the Forest will continue to provide opportunities for the use and enjoyment of various fish, wildlife, and plant species, either consumptively or non-consumptively. Recreation spending and economic contributions (in terms of employment, income, and GDP contributions) to the local economy from fishing, hunting, and wildlife viewing activities as described in the *Outdoor Recreation* section will continue to be sustained under existing conditions. Across alternatives B, C, and D, people who visit the Forest, as well as others who may never visit, will continue to hold passive use values associated with the enjoyment of fish, wildlife, and plant species.

Some segments of the public holding passive use values associated with the Forest's fish, wildlife, and plant species would likely prefer alternative D over the other alternatives as it provides the greatest number of new recommended wilderness acres, as well as added special interest areas and an additional research natural area to the system. Passive use value holders may perceive these plan area directions and components to be most protective of fish, wildlife, and plant species, regardless of subsequent effects from implementation of the forest plan and the actual level of protections for species. This is reflective of the distinct nature of passive use value, where the level of enjoyment and benefit a person receives is not contingent upon the actual use, sighting, or experience otherwise.

Mineral Resource Activities

Under the no-action alternative, mining would continue to support very little employment and income unless silver mining in Creede, Colorado, becomes economically viable. Potential employment and income estimates related to silver mining are not possible and would require data on annual extraction and future prices; these data are difficult to estimate and are likely to be based on proprietary information.

Under alternative B there are approximately 58,669 acres of recommended wilderness, which would reduce the area available for mineral extraction and energy development. This would reduce the potential for increased employment and labor income relative to the no-action alternative. However, neither the availability nor the potential for mining in these areas has been described. Thus, the loss of these acres for potential mining may also have no economic impact.

Alternative C would have the same effect as alternative A, the no-action alternative.

Under alternative D, there is 284,853 acres of recommended wilderness, which would reduce the area available for mineral extraction and energy development. This would reduce the potential for increased employment and labor income relative to the no-action alternative. However, neither the availability nor the potential for mining in these areas has been described. Thus, the loss of these acres for potential mining may also have no economic impact.

Effects on Infrastructure from Management of Other Resources

As discussed in the *Forest Contributions* section, budgetary limitations have resulted in the deferment of a number of critical maintenance needs on infrastructure. However, evaluations for decommissioning existing facilities and new construction are not addressed at the forest plan level. In 2017 a facility master plan was completed to guide the acquisition, use, improvements, disposal, and maintenance of Forest Service administrative facilities.

It is important to note that degradation of infrastructure would have both social and economic consequences for stakeholders who use the Forest for various social, recreational, and cultural reasons, and for users who rely on the infrastructure for direct economic purposes, such as grazing and timber. These economic losses are not quantifiable; however, spending on infrastructure would provide employment and income to local communities as well as support social and economic activities occurring on the Forest.

Under alternative D, some of the proposed special interest areas and recommended wilderness may change some of the allowable trail usage and possibly reduce the number of motorized trails. This may impact the quality of life for individuals who rely on these trails for numerous activities, including recreation, hunting, grazing, etc. Under alternatives B and C there would be little to no effect on the current status of infrastructure, nor to the current social and economic impact of infrastructure.

Effects on Forest Service Presence in the Community from Management of Other Resources

Activities described under each alternative are not anticipated to impact the level of Forest spending, employment levels, or PILT and SRS payments. Rather, external forces outside of these activities would have the largest impact, such as any potential reduction in the Forest's budget or Executive order requirements to reorganize and streamline Federal agencies, which might reduce the overall agency workforce (Executive order, unnumbered, Presidential Executive Order on a Comprehensive Plan for Reorganizing the Executive Branch, March 13, 2017).

It is anticipated that employment levels will rise slightly in 2017 by about 7 full-time employees and 14 part-time employees (data based off information provided by the Forest budget office). Additionally, if Forest spending in 2017 remains similar to the 5-year average, (totaling $12 million annually), then Forest expenditures would support 260 full- and part-time jobs and $10.1 million in labor income annually.

As discussed in the *Forest Contributions* section, the reauthorization of SRS payments is a critical component related to economic and social impacts to the communities surrounding the Forest. However, these decisions are made outside of the local area and are not directly impacted by forest plan revision. Since SRS inception, these funds have always been reauthorized; however, future approval is difficult to predict through the life of the forest plan. In addition to the risk of program cancelation, payments could be delayed or reduced. If SRS is not reauthorized, the program would revert back to the 25-percent fund. If this were the case, it is likely that rural counties that rely on SRS payments (the San Luis Valley area of influence) would prefer alternative C. In short, the 25-percent fund distributes to counties (where the Forest is situated) 25 percent of the receipts received from timber, grazing, mineral extraction, recreation, and power generation (USDA Forest Service 2013a, b).

Alternative C proposes to increase the acreage available for multiple uses, particularly for timber extraction. Therefore, a larger 25-percent fund payment would be expected. The volume of timber removed from the Forest under alternative C might be enough to overcome a loss of SRS funds; however, the large volume is primarily salvage timber (as described in the *Forested Ecosystems* section). Therefore, larger 25-percent fund payments would not occur indefinitely and overall, a loss of SRS payments would have long-term negative economic consequences for the San Luis Valley area of influence.

County-Level Summaries on Social and Economic Sustainability and Plan Area Contributions

In the San Luis Valley area of influence, the Forest will continue to contribute to social and economic sustainability by providing for multiple uses, ecosystem services, and infrastructure, and by having a presence in the community. While timber harvest, ranching, recreation, and other resources including ecosystem services will continue to play an important economic and social role in the area, individual counties may experience different levels of contributions, as well as varying degrees of progress toward the path of sustainable economic development. With the concept of sustainability (resiliency and efficiency) in mind, the following summaries focus on different indicators and factors of economic sustainability (as introduced in the *Affected Environment* section) for each county in the San Luis Valley area of influence, in relation to various plan area contributions. Note that the summary for Alamosa County includes definitions and other information to aid interpretation, while summaries for other counties are more focused on data and are further abbreviated.

Alamosa County

The Forest contributes to Alamosa County's economy in various ways, especially through grazing and recreation opportunities, and to a lesser extent SRS and PILT payments. The county is classified as 'isolated' according to the market access classification system, as described in the *Factors of Social and Economic Sustainability in the Forest's Area of Influence* section and Table 98. Alamosa County is specialized in the government sector (which includes federal and state employment and activities) according to the ERS economic dependence typology.

Additionally, the economic base analysis (Table 99) shows that 34 percent of Alamosa County's employment base belongs in the *Local Residential Services* sector (services paid for by earnings, taxes, rents, etc.), while 7 percent belongs in the *Indirect Basic* section (local stores, services, goods, labor, etc. that are needed to support the *Direct Basic Industry*). Direct basic industry makes up 59 percent of Alamosa County's economy, the lowest among the seven-county area of influence. Direct basic sectors are the driver of growth, the industry that exports its goods or services outside the local economy and brings in outside dollars. Besides government services, the economic base analysis revealed that the county has a high share of total direct basic employment in the regional services category (regional services are industries that may provide direct basic services/goods to outside consumers, and services and employment to local residents). Based on this information, the largest economic impact to Alamosa County associated with the Forest would result from activities outside of forest plan revision. For example, SRS and PILT payments and/or changes to federal and state employment levels and spending are not impacted by the forest plan.

About 14 percent of all employees in Alamosa County belong in the creative class, which is below both the national and state (Colorado) averages (18 percent and 23 percent, respectively). The creative class thesis is described in the *Creative Class Employment* section; in short, it proposes the need for communities and towns to attract engineers, architects, artists, and people in other creative occupations to be competitive in today's economy. This is particularly relevant in rural areas that tend to lose much of their young talent to larger cities. However, Alamosa's median age is quite low (30.1), well below the national and state average.

Productivity is measured by GDP per worker, with $93,900 per worker, Alamosa County has the highest GDP per worker value within the seven-county area, which is close to the national average of $94,400. High versus low productivity is a concern because productivity growth is a crucial determinant of living standards for future generations. See the *Measures of Productivity* section for further details.

As for economic diversity, Alamosa County has a Shannon-Weaver diversity index of 0.66, which is the most diverse within the seven-county area (the State of Colorado has a value of 0.76). The Shannon-Weaver index is described in the *Economic Diversity* section, but in short, it provides an index that accounts for both numbers of industries and the spread of employment across those industries. Economies with greater economic diversity are able to endure economic shocks and recessions better than highly specialized economies. If there were a dramatic change to industries that a county is specialized in, that county would experience a greater economic impact, either positive or negative. Relative to contributions from the Forest, because Alamosa County is more diverse, it would be less likely to experience dramatic economic impacts, if plan area contributions were to change, for instance.

Lastly, with regards to civilian labor force in the future, total civilian employment demands are projected to increase through 2040 (annual average increases of 0.9 percent), with the majority of growth occurring during the initial years. Demand for tourism-related employment is not projected to increase notably.

Relative to plan area contributions, Alamosa County is not likely to see significant economic changes from current conditions. Range availability is anticipated to be identical across alternatives A through C, and reductions associated with alternative D are expected to be minor. It is not known if increased travel costs for grazing permittees under alternative D will impact residents of Alamosa County. With regards to recreation, alternative B would provide the greatest mix of recreation uses; therefore, it is likely to provide the largest positive economic impact. Because alternative D would restrict off-road big game retrieval during hunting season and some motorized access, it may negatively impact recreation spending. These negative economic impacts are likely to be marginal. Additionally, depending upon the amount of increase in dispersed recreation users under alternative D, spending associated with those additional uses might offset the loss of motorized recreation.

Conejos County

The Forest contributes to Conejos County's economy in various ways, especially through grazing, timber, and recreation opportunities, and to a large extent, PILT and SRS payments, as nearly 60 percent of the land in Conejos County is federally owned. The county is classified as an isolated farm-dependent county according to the market access classification and economic dependency typology systems. This means that farm earning accounts for 25 percent or more of total county earnings, or at least 16 percent of total employment is in the farm sector. Conejos County's economy is almost exclusively employed in the direct base economy (91 percent), where those direct base industries are largely agriculture (30 percent) and commuters (20 percent). A large commuter base indicates that many residents of Conejos County travel outside of the local area to obtain employment. This indicates that the local economy lacks sufficient opportunities within Conejos County's boundaries. Based on Conejos County's reliance on the agriculture industry and its dependence on the economic opportunities the Forest provides in timber, grazing, and recreation, plan area directions and management of public lands in general have the potential to have meaningful impacts on the local economy.

About 11.6 percent of all employees in Conejos County belong in the creative class; this is below both the national and state (Colorado) averages (18 percent and 23 percent, respectively). These values are not surprising considering that the base economy is rooted in agriculture. As discussed in the *Alamosa County* section, economies without a creative class of employment are at risk of losing their young workforce to cities. Alamosa County's base economy is also heavily rooted in the commuter sector, indicating that the creative class may already be seeking employment outside of the local area.

Productivity is measured by GDP per worker. At $58,400 per worker, Conejos County has a GDP per worker value well below the national average of $94,400. While not the lowest in the area of influence, it remains a concern. High versus low productivity is a crucial determinant of living standards for future generations. See the *Measures of Productivity* section for further details.

In regards to economic diversity, Conejos County has a Shannon-Weaver diversity index of 0.61 (the State of Colorado has a value of 0.76), which is the average for the San Luis Valley area of influence. Economies with greater economic diversity are able to endure economic shocks and recessions better than highly specialized economies. If there were a dramatic change to industries a county is specialized in, that county would see a greater economic impact, either positive or negative. Relative to contributions from the Forest, because Conejos County is more diverse, it would be less likely to see dramatic economic impacts, if the Plan Area's contributions were to change, for instance.

Lastly, with regards to civilian labor force in the future, civilian employment demands are projected to increase through 2040 by about 0.3 percent on an annual average basis, with the majority of growth occurring during the initial years. Demand for tourism-related employment is projected to remain flat or decline marginally (Table 100).

In addition to a largely flat civilian labor force in the near future, the county is agriculturally dependent and isolated, with relatively low creative class employment and economic diversity. Therefore, relative to plan area contributions, Conejos County is more likely to experience subsequent economic effects, if any, on its local economy than others within the

San Luis Valley area of influence. As described above, the county's economy relies on access to forage for grazing, as well as timber, and recreation opportunities provided by the Forest. Range availability is anticipated to be identical across alternatives A through C, and reductions in available acres associated with alternative D are expected to be minor. It is not known if increased travel costs for grazing permittees under alternative D will impact Conejos County residents. With regards to recreation, alternative B would provide the greatest mix of recreation uses; therefore, it is likely to provide the largest positive economic impact. Because alternative D would restrict off-road game retrieval and some motorized access, it may negatively impact recreation spending. These negative economic impacts are likely to be marginal. Additionally, depending upon the amount of increase in dispersed recreation users under alternative D, spending associated with those additional uses might offset the loss of motorized recreation. Occupations involved in timber-related sectors likely would prefer alternative C, which provides the largest volume of timber for extraction. Alternative D would be the least preferred alternative, and alternative B would be preferred to alternative D, where projected timber sale volumes are higher.

Costilla County

The Forest contributes to Costilla County's economy primarily through recreation, and to a very small extent through grazing. Costilla County is classified as an isolated farm-dependent county according to the market access classification and economic dependency typology systems. The county is mostly employed in the direct base economy (88 percent). Direct base industries are largely agriculture-related (37 percent) and retiree income (24 percent). Retirees as a base industry have significant long-term implications as any subsequent changes (i.e., the number of retirees living in the county) will have a sizable impact on indirect and local residential services, particularly health care, residential services, and local government activities and services supported by taxable income. Despite Costilla County's reliance on the agricultural industry, very little of the sector is supported through the Forest. Instead, recreation is the primary economic connection. Recreation accounts for only 3 percent of the total civilian labor force, and this is not projected to increase through 2040 (Table 100). Based on the minimal economic dependence Costilla County has on products and uses on the Forest, it is unlikely that plan area direction has the potential to have substantial impacts on the local economy. However, Mount Blanca is within Costilla County's boundaries and is important socially.

Productivity is measured by GDP per worker. At $59,100 per worker, Costilla County is well below national average ($94,400). While not the lowest in the area of influence, it remains a concern. High versus low productivity is a crucial determinant of living standards for future generations. See the *Measures of Productivity* section for further details.

In regards to economic diversity, Costilla County has a Shannon-Weaver diversity index of 0.58 (the State of Colorado is 0.76). Economies with greater economic diversity are able to endure economic shocks and recessions better than highly specialized economies.

About 15.2 percent of all employees in Costilla County belong in the creative class, which is below both the national and state (Colorado) averages (18 percent and 23 percent, respectively). These values are not surprising considering that the base economy is rooted in agriculture. Economies without a creative class of employment are at risk of losing their young workforce. Costilla County's median age is already quite high (49.0), well above the state (Colorado) and national average (Table 88), indicating that young talent has sought employment elsewhere.

Based on the small and declining amount of tourism-related employment in the county and the lack of dependence of grazing and timber forest products from the Forest, it is unlikely that any alternative will have a significant economic impact. However, those industries that are recreation dependent would likely prefer alternative B, which would provide the greatest mix of recreation uses and therefore is likely to provide the largest positive economic impact. Because alternative D would restrict off-road game retrieval and some motorized access, it may negatively impact recreation spending. These negative economic impacts are likely to be marginal. Additionally, depending upon the amount of increase in dispersed recreation users under alternative D, spending associated with those additional uses might offset the loss of motorized recreation.

Hinsdale County

The Forest contributes to Hinsdale's economy in various ways, especially through recreation and timber, and to a lesser extent through SRS and PILT payments. Hinsdale is classified as an isolated recreation-dependent county according to the market access classification and economic dependency typology systems. The county is mostly employed in the direct base economy (88 percent). Direct base industries are largely tourism-related (33 percent) and retiree income (31 percent). Retirees as a base industry have significant long-term implications as any subsequent changes (i.e., the number of retirees living in the county) will have a sizable impact on indirect and local residential services, particularly health care, residential services, and local government activities and services supported by taxable income. Based on Hinsdale County's reliance on the recreation industry and its dependence on the recreation opportunities (including scenery and other natural amenities) the Forest provides, plan area direction has the potential to have meaningful impacts on the local economy. Ninety-six percent of the Hinsdale County land base is in federal ownership, and only one community exists.

Productivity is measured by GDP per worker. At $52,400 per worker, Hinsdale County is well below the national average ($94,400) and has the lowest productivity per worker in the 16-county social and economic area of influence. Economic productivity is a crucial determinant of living standards for future generations because productivity is interrelated with economic efficiency, and economies that lack efficiency risk being stagnant.

In regards to economic diversity, Hinsdale County has a Shannon-Weaver diversity index of 0.58 (the State of Colorado is 0.76). Economies with greater economic diversity are able to endure economic shocks and recessions better than highly specialized economies. Relative to contributions from the Forest, because Hinsdale County is less diverse, it would be more likely to experience changes in the local economy, if the plan area's contributions were to change, for instance.

About 30 percent of all employees in Hinsdale County belong in the creative class, which is above both the national and state (Colorado) averages (18 percent and 23 percent, respectively). Local economies with a strong creative class of employment are in a better position to attract and retain younger talents. This will become increasingly important for counties with a sizable direct basic industry reliant on the retiree income category, especially if the number of incoming retirees decreases in the future.

Lastly, with regards to labor force, civilian employment demands are projected to grow at an annual average rate of 1.3 percent through 2040. Demand for tourism-related employment is projected to grow marginally at less than 1 percent over the same period (Table 100).

In addition to a slow-growing tourism-related labor force in the near future, the county is recreation-dependent and isolated, with a relatively high creative class employment but lower economic diversity and productivity. Therefore, relative to plan area contributions, Hinsdale County is more sensitive to subsequent economic effects, if any, on its local economy than others within the area of influence. With regards to recreation, alternative B would provide the greatest mix of recreation uses; therefore, it is likely to provide the largest positive economic impact. Because alternative D would restrict off-road game retrieval and some motorized access, it may negatively impact recreation spending. These negative economic impacts are likely to be marginal. Additionally, depending upon the amount of increase in dispersed recreation users under alternative D, spending associated with those additional uses might offset the loss of motorized recreation.

Mineral County

Like Hinsdale County, the Forest contributes to Mineral County's economy in various ways, especially through timber and recreation opportunities, and to a lesser extent through SRS and PILT payments. Mineral County is classified as an isolated recreation-dependent county according to the market access classification and economic dependency typology systems. The county is mostly employed in the direct base economy (81 percent). Direct base industries are largely tourism-related (68 percent) with a sizable portion in the retiree income category. Retirees as a base industry have significant long-term implications because any subsequent changes (i.e., the number of retirees living in the county) will have a sizable impact on indirect and local residential services, particularly, health care, residential services, and local government activities and services supported by taxable income. Based on Mineral County's reliance on the recreation industry and its dependence on the recreation opportunities (including scenery and other natural amenities) the Forest provides, plan area direction has the potential to have meaningful impacts on the local economy.

Productivity is measured by GDP per worker. At $55,500 per worker, Mineral County is well below national average ($94,400). Economic productivity is a crucial determinant of living standards for future generations.

In regards to economic diversity, Mineral County has a Shannon-Weaver diversity index of 0.55 (the State of Colorado is 0.76). Economies with greater economic diversity are able to endure economic shocks and recessions better than highly specialized economies. Relative to contributions from the Forest, because Mineral County is less diverse, it would be more likely to experience changes in the local economy, if the plan area's contributions were to change, for instance. Mineral County has a larger percentage of its land base in federal ownership, with only one community.

About 27 percent of all employees in Mineral County belong in the creative class, which is above both the national and state (Colorado) averages (18 percent and 23 percent, respectively). Local economies with a strong creative class of employment are in a better position to attract and retain younger talents. This will become increasingly important for counties with a sizable direct basic industry reliant on the retiree income category, especially if the number of incoming retirees decreases in the future.

Lastly, with regards to civilian labor force in the future, civilian employment demands are projected to grow at an annual average rate of 2 percent until 2020 and then decline at an annual rate of 0.3 percent through 2040. Demand for tourism-related employment is projected to remain flat (Table 100).

In addition to a largely flat and declining tourism-related labor force in the near future, the county is recreation dependent and isolated, with a relatively high creative class employment but lower economic diversity and productivity. Therefore, relative to plan area contributions, Mineral County is more sensitive to subsequent economic effects, if any, on its local economy than others within the San Luis Valley area of influence. With regards to recreation, alternative B would provide the greatest mix of recreation uses; therefore, it is likely to provide the largest positive economic impact. Because alternative D would restrict off-road game retrieval and some motorized access, it may negatively impact recreation spending. These negative economic impacts are likely to be marginal. Additionally, depending upon the amount of increase in dispersed recreation users under alternative D, spending associated with those additional uses might offset the loss of motorized recreation.

Rio Grande County

The Forest contributes to the local economy in Rio Grande County in various ways, especially through timber, grazing, and recreation opportunities, and to some extent through SRS and PILT payments. Rio Grande County is classified as an isolated, nonspecialized county according to the market access classification and economic dependency typology systems. Nonspecialized counties were counties that did not qualify for either the farming, mining, manufacturing, Federal/State government, or recreation dependency criteria. The county is mostly employed in the direct base economy (79 percent). Rio Grande County's direct base industries are largely agriculture (40 percent). Based on the county's reliance on the agriculture industry and its dependence on the economic opportunities the Forest provides in timber, grazing, and recreation, forest plan revision has the potential to have meaningful impacts on the local economy.

About 18 percent of all employees in Rio Grande County belong in the creative class, which is at the state average, but below the national average (23 percent). Economies without a creative class of employment are at risk of losing their young workforce.

Productivity is measured by GDP per worker, At $90,300 per worker, Rio Grande County is near national average ($94,400).

As for economic diversity, Rio Grande County has a Shannon-Weaver diversity index of 0.63, which is near the San Luis Valley area average (the State of Colorado is 0.76). Economies with greater economic diversity are able to endure economic shocks and recessions better than highly specialized economies.

Lastly, with regards to labor force in the future, civilian employment demands are projected to remain flat. Tourism-related employment demand, however, is projected to decline the most during the decade prior to 2040 (about 70 jobs).

In addition to a largely flat and declining civilian labor force, the county is nonspecialized and isolated, with relatively average productivity, creative class employment, and economic diversity. Therefore, relative to plan area contributions, Rio Grande County may be subject to subsequent economic effects, if any, on its local economy. Range availability is anticipated to be identical across alternatives A through C, and reductions associated with alternative D are expected to be minor. It is not known if increased travel costs for grazing permittees under alternative D will impact Rio Grande County residents. With regards to recreation, alternative B would provide the greatest mix of recreation uses; therefore, it is likely to provide the largest positive economic impact. Because alternative D would restrict off-road game retrieval and some motorized access, it may negatively impact recreation spending. These negative economic impacts are likely to be marginal. Additionally, depending upon the amount of increase in dispersed recreation users under alternative D, spending associated with those additional uses might offset the loss of motorized recreation. Occupations involved in timber-related sectors would prefer alternative C, which provides the largest volume of timber for extraction. Alternative D would be the least preferred alternative, and alternative B would be preferred to alternative D, where projected timber sale volumes are higher.

Saguache County

The Forest contributes to Saguache County's economy in various ways, especially through timber, grazing, and recreation opportunities, and to a large extent through SRS taxes and PILT payments. Saguache is classified as an isolated farm-dependent county according to the market access classification and economic dependency typology systems. The county's economy is almost exclusively employed in the direct base economy (92 percent). Direct base industries are largely agriculture (46 percent). Based on Saguache County's reliance on the agriculture industry and its dependence on the economic opportunities the Forest provides in timber, grazing, and recreation, forest plan revision has the potential to have meaningful impacts on the local economy.

About 15 percent of all employees in Saguache County belong in the creative class, which is below both the national and state (Colorado) averages (18 percent and 23 percent, respectively). These values are not surprising considering that the base economy is rooted in agriculture. Economies without a creative class of employment are at risk of losing their young workforce.

Productivity is measured by GDP per worker. At $78,200 per worker, Saguache County is below national average ($94,400). Low productivity is a crucial determinant of living standards for future generations.

In regards to economic diversity, Saguache County has a Shannon-Weaver diversity index of 0.59 (the State of Colorado is 0.76). Economies with greater economic diversity are able to endure economic shocks and recessions better than highly specialized economies. Relative to contributions from the Forest, because Saguache County is less diverse, it would be more likely to experience changes in the local economy if plan area contributions were to change, for instance.

Lastly, with regards to civilian labor force in the future, civilian employment demands are projected to remain flat through 2040 with some growth during the initial years (annual average increase of 0.64 percent), and then decline marginally by 2040 (0.2 percent annual decline). Demand for tourism-related employment is projected to remain flat (Table 100).

In addition to a largely flat civilian labor force in the near future, the county is agriculturally dependent and isolated, with relatively lower creative class employment and economic diversity. Therefore, relative to plan area contributions, Saguache County is more likely to experience subsequent economic effects, if any, on its local economy than others within the area of influence. Range availability is anticipated to be identical across alternatives A through C, and reductions associated with alternative D are expected to be minor. It is not known if increased travel costs for grazing permittees under alternative D will impact Saguache residents. With regards to recreation, alternative B would provide the greatest mix of recreation uses; therefore, it is likely to provide the largest positive economic impact. Because alternative D would restrict off-road game retrieval and some motorized access, it may negatively impact recreation spending. These negative economic impacts are likely to be marginal. Additionally, depending upon the amount of increase in dispersed recreation users under alternative D, spending associated with those additional uses might offset the loss of motorized recreation. Occupations involved in timber-related sectors would prefer alternative C, which provides the largest volume of timber for extraction. Alternative D would be the least preferred alternative, and alternative B would be preferred over alternative D, where projected timber sale volumes are higher.

Table 110. Annual average economic contributions (jobs, income, and GDP) by industries based on total projected timber sale and wood sale quantities, including salvage volume, alternatives A and B (1st decade)

	Employment (# of full and part-time Jobs)			Labor Income (Thousands of 2014$)			GDP (Thousands of 2014$)		
	Total	Direct	Indirect & Induced	Total	Direct	Indirect & Induced	Total	Direct	Indirect & Induced
Agriculture	134	105	29	5,199	4,417	782	6,836	5,500	1,336
Mining	1	0	1	79	0	79	160	0	160
Utilities	3	0	3	184	0	184	595	0	595
Construction	6	0	6	173	0	173	213	0	213
Manufacturing	147	135	12	4,508	4,132	375	5,407	4,959	449
Wholesale Trade	15	0	15	868	0	868	1,495	0	1,495
Transportation and Warehousing	14	0	14	624	0	624	803	0	803
Retail Trade	14	0	14	438	0	438	687	0	687
Information	3	0	3	142	0	142	355	0	355
Finance & Insurance	9	0	9	444	0	444	628	0	628
Real Estate & Rental & Leasing	9	0	9	112	0	112	1,646	0	1,646
Professional, Scientific, and Technical Services	17	0	17	727	0	727	842	0	842
Management of Companies and Enterprises	4	0	4	193	0	193	247	0	247
Administration, Waste & Remediation Service	15	0	15	288	0	288	351	0	351
Educational Services	2	0	2	36	0	36	39	0	39
Health Care and Social Assistance	15	0	15	722	0	722	795	0	795
Arts, Entertainment, and Recreation	6	0	6	71	0	71	117	0	117
Accommodation and Food Services	16	0	16	336	0	336	520	0	520
Other Services	12	0	12	495	0	495	628	0	628
Government & Others	3	0	3	140	0	140	145	0	145
Total	445	240	205	15,778	8,549	7,229	22,510	10,458	12,052

Table 111. Annual average economic contributions (jobs, income, and GDP) by industries based on total projected timber sale and wood sale quantities, no salvage volume, alternatives A and B (2nd decade)

	Employment (# of full and part-time Jobs)			Labor Income (Thousands of 2014$)			GDP (Thousands of 2014$)		
	Total	Direct	Indirect & Induced	Total	Direct	Indirect & Induced	Total	Direct	Indirect & Induced
Agriculture	33	27	6	1,310	1,131	179	1,713	1,409	305
Mining	0	0	0	16	0	16	31	0	31
Utilities	1	0	1	37	0	37	111	0	111
Construction	1	0	1	37	0	37	41	0	41
Manufacturing	30	28	3	932	853	78	977	895	82
Wholesale Trade	3	0	3	191	0	191	290	0	290
Transportation & Warehousing	3	0	3	144	0	144	154	0	154
Retail Trade	3	0	3	99	0	99	141	0	141
Information	1	0	1	34	0	34	68	0	68
Finance and Insurance	2	0	2	99	0	99	124	0	124
Real Estate & Rental & Leasing	2	0	2	25	0	25	340	0	340
Professional, Scientific, and Technical Services	4	0	4	166	0	166	160	0	160
Management of Companies and Enterprises	1	0	1	44	0	44	45	0	45
Administration, Waste and Remediation Service	3	0	3	67	0	67	67	0	67
Educational Services	0	0	0	8	0	8	8	0	8
Health Care and Social Assistance	3	0	3	164	0	164	166	0	166
Arts, Entertainment, and Recreation	1	0	1	16	0	16	23	0	23
Accommodation & Food Services	3	0	3	76	0	76	104	0	104
Other Services	3	0	3	111	0	111	128	0	128
Government and Others	1	0	1	31	0	31	28	0	28
Total	100	55	45	3,608	1,984	1,623	4,719	2,303	2,416

Table 112. Annual average economic contributions (jobs, income, and GDP) by industries based on total projected timber sale and wood sale quantities, with salvage volume, alternative C (years 1–6)

	Employment (# of full and part-time Jobs)			Labor Income (Thousands of 2014$)			GDP (Thousands of 2014$)		
	Total	Direct	Indirect & Induced	Total	Direct	Indirect & Induced	Total	Direct	Indirect & Induced
Agriculture	256	201	55	9,957	8,457	1,500	13,095	10,530	2,565
Mining	3	0	3	151	0	151	307	0	307
Utilities	6	0	6	353	0	353	1,146	0	1,146
Construction	12	0	12	332	0	332	411	0	411
Manufacturing	284	260	23	8,667	7,945	722	10,420	9,555	865
Wholesale Trade	28	0	28	1,667	0	1,667	2,877	0	2,877
Transportation & Warehousing	27	0	27	1,196	0	1,196	1,545	0	1,545
Retail Trade	26	0	26	840	0	840	1,322	0	1,322
Information	5	0	5	271	0	271	684	0	684
Finance and Insurance	18	0	18	853	0	853	1,209	0	1,209
Real Estate & Rental & Leasing	17	0	17	214	0	214	3,165	0	3,165
Professional, Scientific, and Technical Services	33	0	33	1,396	0	1,396	1,622	0	1,622
Management of Companies and Enterprises	8	0	8	371	0	371	476	0	476
Administration, Waste and Remediation Service	29	0	29	553	0	553	677	0	677
Educational Services	4	0	4	70	0	70	75	0	75
Health Care and Social Assistance	29	0	29	1,387	0	1,387	1,528	0	1,528
Arts, Entertainment, and Recreation	11	0	11	137	0	137	225	0	225
Accommodation & Food Services	30	0	30	644	0	644	1,000	0	1,000
Other Services	23	0	23	951	0	951	1,208	0	1,208
Government and Others	6	0	6	269	0	269	278	0	278
Total	855	461	394	30,280	16,402	13,878	43,269	20,085	23,184

Table 113. Annual average economic contributions (jobs, income, and GDP) by industries based on total projected timber sale and wood sale quantities, no salvage volume, alternative C (year 7 through 2nd decade)

	Employment (# of full and part-time Jobs)			Labor Income (Thousands of 2014$)			GDP (Thousands of 2014$)		
	Total	Direct	Indirect & Induced	Total	Direct	Indirect & Induced	Total	Direct	Indirect & Induced
Agriculture	60	48	12	2,340	2,020	320	3,059	2,515	544
Mining	0	0	0	29	0	29	55	0	55
Utilities	1	0	1	66	0	66	198	0	198
Construction	2	0	2	66	0	66	72	0	72
Manufacturing	54	50	4	1,663	1,524	140	1,745	1,598	147
Wholesale Trade	6	0	6	340	0	340	518	0	518
Transportation & Warehousing	6	0	6	257	0	257	275	0	275
Retail Trade	5	0	5	177	0	177	252	0	252
Information	1	0	1	61	0	61	122	0	122
Finance & Insurance	4	0	4	176	0	176	222	0	222
Real Estate & Rental & Leasing	4	0	4	46	0	46	607	0	607
Professional, Scientific, and Technical Services	7	0	7	297	0	297	285	0	285
Management of Companies and Enterprises	2	0	2	78	0	78	81	0	81
Administration, Waste and Remediation Service	6	0	6	119	0	119	119	0	119
Educational Services	1	0	1	15	0	15	15	0	15
Health Care and Social Assistance	6	0	6	292	0	292	297	0	297
Arts, Entertainment, and Recreation	2	0	2	29	0	29	42	0	42
Accommodation & Food Services	6	0	6	136	0	136	185	0	185
Other Services	5	0	5	199	0	199	229	0	229
Government and Others	1	0	1	55	0	55	50	0	50
Total	178	98	80	6,442	3,544	2,898	8,427	4,113	4,314

Table 114. Annual average economic contributions (jobs, income, and GDP) by industries based on total projected timber sale and wood sale quantities, with salvage volume, alternative D (1st decade)

	Employment (# of full and part-time Jobs)			Labor Income (Thousands of 2014$)			GDP (Thousands of 2014$)		
	Total	Direct	Indirect & Induced	Total	Direct	Indirect & Induced	Total	Direct	Indirect & Induced
Agriculture	73	57	16	2,821	2,397	424	3,709	2,985	725
Mining	1	0	1	43	0	43	86	0	86
Utilities	2	0	2	99	0	99	322	0	322
Construction	3	0	3	94	0	94	116	0	116
Manufacturing	80	73	6	2,443	2,240	203	2,929	2,685	243
Wholesale Trade	8	0	8	471	0	471	810	0	810
Transportation & Warehousing	8	0	8	338	0	338	435	0	435
Retail Trade	7	0	7	237	0	237	373	0	373
Information	1	0	1	77	0	77	192	0	192
Finance and Insurance	5	0	5	241	0	241	340	0	340
Real Estate & Rental & Leasing	5	0	5	61	0	61	892	0	892
Professional, Scientific, and Technical Services	9	0	9	394	0	394	456	0	456
Management of Companies and Enterprises	2	0	2	105	0	105	134	0	134
Administration, Waste and Remediation Service	8	0	8	156	0	156	190	0	190
Educational Services	1	0	1	20	0	20	21	0	21
Health Care and Social Assistance	8	0	8	392	0	392	431	0	431
Arts, Entertainment, and Recreation	3	0	3	39	0	39	63	0	63
Accommodation & Food Services	9	0	9	182	0	182	282	0	282
Other Services	7	0	7	269	0	269	340	0	340
Government and Others	2	0	2	76	0	76	78	0	78
Total	242	130	111	8,556	4,636	3,920	12,200	5,670	6,530

Table 115. Annual average economic contributions (jobs, income, and GDP) by industries based on total projected timber sale and wood sale quantities, no salvage volume, alternative D (2nd decade)

	Employment (# of full and part-time Jobs)			Labor Income (Thousands of 2014$)			GDP (Thousands of 2014$)		
	Total	Direct	Indirect & Induced	Total	Direct	Indirect & Induced	Total	Direct	Indirect & Induced
Agriculture	16	13	3	624	539	85	816	671	145
Mining	0	0	0	8	0	8	15	0	15
Utilities	0	0	0	18	0	18	53	0	53
Construction	1	0	1	18	0	18	19	0	19
Manufacturing	14	13	1	444	406	37	465	426	39
Wholesale Trade	1	0	1	91	0	91	138	0	138
Transportation & Warehousing	1	0	1	69	0	69	73	0	73
Retail Trade	1	0	1	47	0	47	67	0	67
Information	0	0	0	16	0	16	33	0	33
Finance and Insurance	1	0	1	47	0	47	59	0	59
Real Estate & Rental & Leasing	1	0	1	12	0	12	162	0	162
Professional, Scientific, and Technical Services	2	0	2	79	0	79	76	0	76
Management of Companies and Enterprises	0	0	0	21	0	21	22	0	22
Administration, Waste and Remediation Service	2	0	2	32	0	32	32	0	32
Educational Services	0	0	0	4	0	4	4	0	4
Health Care and Social Assistance	2	0	2	78	0	78	79	0	79
Arts, Entertainment, and Recreation	1	0	1	8	0	8	11	0	11
Accommodation & Food Services	2	0	2	36	0	36	49	0	49
Other Services	1	0	1	53	0	53	61	0	61
Government and Others	0	0	0	15	0	15	13	0	13
Total	47	26	21	1,718	945	773	2,247	1,097	1,150

Chapter 4. Consultation and Coordination

List of Preparers

The preparation of this draft environmental impact statement and draft revised forest plan has been a major undertaking. This list of preparers is limited to those people who were members of the interdisciplinary team working on these documents. The preparation of these documents could not have been completed without the support and assistance of the employees of the Rio Grande National Forest and our colleagues in the Rocky Mountain Regional Office. We also recognize the forest leadership team as providing guidance during this process.

Core Interdisciplinary Team

The core interdisciplinary team (Table 116) developed plan components and alternatives, and wrote the analysis for the draft environmental impact statement. Rio Grande National Forest and Rocky Mountain Regional Office team members communicated primarily virtually and met in person at critical points of integration of the documents.

Table 116. Core interdisciplinary team

Name	Position Title	Team Role
Rio Grande National Forest		
Erin Minks	Forest Planner	Co-Interdisciplinary Team Lead
Judi Pérez	Range, Soils, Water, Invasive Program Lead	Co-Interdisciplinary Team Lead
Ivan Geroy	Forest Hydrologist	Water/Wild and Scenic Rivers
Randy Ghormley	Forest Wildlife Biologist	Wildlife
Carlos Gonzales	Recreation, Lands, and Heritage Program Manager	Recreation/Scenery/Wilderness/Lands
Sid Hall	Prescribed Fire and Fuels Specialist	Fire/Fuels
Angie Krall	Forest Archaeologist	Archaeology/Heritage Resources/Tribal
Chad Lewis	Forest Fire Management Officer	Fire/Fuels
Patrick Moran	Forest Geologist	Geology/Minerals
Jason Remshardt	Forest Fisheries Biologist	Fisheries/Wild and Scenic Rivers
Kirby Self	Vegetation Program Manager	Timber/Silviculture
Vaughn Thacker	Forest Soil Scientist	Soils/Air
Rocky Mountain Regional Office, Forest Plan Revision Support Team		
Chris Wehrli	Environmental Coordinator, Team Leader	Regulation Compliance/Regional Office Guidance
Tim Croissant	Wildlife Biologist	Wildlife
Ellen Hardy	Writer/Editor	Writer/Editor
Natalie Heberling	Geospatial Analyst	GIS Support/Wilderness
Stephanie Rebain	Vegetation Analyst	Vegetation/Timber
Samantha Rider	Recreation Specialist	Recreation/Scenery

Extended Interdisciplinary Team

The extended interdisciplinary team (Table 117) primarily provided support and assistance in reviewing documents for policy consistency. In some cases, team members worked with Forest counterparts to help write plan components and write the analysis for the draft environmental impact statement.

Table 117. Extended interdisciplinary team

Name	Position Title	Team Role
Rio Grande National Forest		
Guy Blackwolf	Environmental Coordinator	Project Record Coordination
Mike Blakeman	Public Affairs Specialist	Public Involvement
Cheryl O'Brien	Forest GIS Coordinator	GIS
Kelly Ortiz	Landscape Architect	Scenery
Andrew Peterson	Realty Specialist	Lands
Meg Sullivan	Forest Engineer	Engineering/Infrastructure
Forest Service Rocky Mountain Regional Office		
Daniel Cressy	Regional Landscape Architect	Recreation/Scenery
Susan Johnson	Regional Tribal Relations Program Manager	Tribal Consultation
Tyler Johnson	Regional Botanist	Rare Plants/Forest Products
Kawa Ng	Regional Economist	Social/Economics/Ecosystem Services
Nikki Sandhoff	Economist	Social/Economics/Ecosystem Services
Julie Schaefers	Regional Social Scientist	Social Science
Trey Schillie	Regional Roadless Projects, Inventory, Monitoring, and Climate Change Coordinator	Climate Change
Donna Shorrock	Regional Vegetation Ecologist, Research Natural Areas Coordinator	Ecology/Research Natural Areas
Forest Service Washington Office		
John Rupe	Planning Specialist	Regulatory Compliance/Regional Office Guidance
Forest Service Rocky Mountain Research Station		
Sean Healy	Research Ecologist	Carbon Analysis
Bureau of Land Management		
Jessica Montag	Social Scientist	Social Science

Forest Strategy and Advisory Team

The Forest strategy and advisory team (Table 118) set the framework for the revision effort, including making decisions on all aspects of the revision effort related to scope, scale, and intensity. They established timeframes, ensured accountability of all personnel involved, and assisted the interdisciplinary team on emerging issues.

Table 118. Forest strategy and advisory team

Name	Position Title
Dan Dallas	Forest Supervisor
Tom Malecek	Deputy Forest Supervisor
Mike Blakeman	Forest Public Affairs Specialist
Andrea Jones	Conejos Peak District Ranger
Tristram Post	Saguache District Ranger
Martha Williamson	Divide District Ranger

List of Federal, State, and Local Cooperators

The following entities to help develop the draft revised plan and draft environmental impact statement as part of this cooperative group:

- Colorado Department of Natural Resources
- Colorado Water Conservation Board
- Colorado Department of Natural Resources
- Colorado State Land Board
- Colorado Parks and Wildlife
- Great Sand Dunes National Park and Preserve
- San Luis Valley Field Office, Bureau of Land Management
- San Luis Valley Refuge Complex, U.S. Fish and Wildlife Service
- Alamosa County
- Conejos County
- Hinsdale County
- Mineral County
- Rio Grande County
- Saguache County
- Navajo Nation

List of Tribal Governments Consulted

The Rio Grande National Forest regularly consults with the 19 tribes, including those listed below:

- The Hopi Tribe
- Uintah and Ouray/Northern Ute Tribe
- Pueblo of Nambe
- Pueblo of Santo Domingo
- San Ildefonso Pueblo
- Ohkay Owingeh
- Santa Clara Pueblo
- Taos Pueblo
- Pueblo de Cochiti
- Pueblo of Picuris
- Pueblo of Zuni
- Pueblo of Laguna
- Pueblo of Acoma
- Comanche Nation

The list below represents the tribes most engaged in the plan revision process. The Navajo Nation's involvement rose to the level of formalized cooperating agency status.

- Navajo Nation
- Southern Ute Tribe
- Jicarilla Apache Nation
- Ute Mountain Ute Tribe
- Pueblo of Santa Ana

References Cited

To facilitate finding, references are grouped by chapter and section.

Summary

USDA Forest Service. 1996. Revised land and resource management plan: Rio Grande National Forest. Prepared by Rio Grande National Forest staff, Monte Vista, Colorado. Accessed August 3, 2017, at: https://www.fs.usda.gov/main/riogrande/landmanagement/planning

Chapter 1. Purpose and Need for Action

Colorado Department of Transportation. 2017. Colorado: The official guide to the scenic and historic byways. Accessed April 25, 2017, at: http://edition.pagesuite-professional.co.uk//launch.aspx?pbid=edfe2883-9dfe-4cb6-ac27-261c2bbba921

Godfrey, A. 2012. From prairies to peaks: A history of the Rocky Mountain Region of the U.S. Forest Service, 1905–2012. USDA Forest Service. ISBN: 9780160914126. 434 pp.

USDA Forest Service. 2016a. The 1996 Rio Grande National Forest: What needs to change. Version 2. 24 pp. Prepared by Rio Grande National Forest, Monte Vista, Colorado. Accessed June 20, 2017, at: https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd514178.pdf

USDA Forest Service. 2016b. Rio Grande National Forest plan revision: Wilderness recommendation process. Prepared by Rio Grande National Forest staff, Monte Vista, Colorado. 15 pp. Accessed June 20, 2017, at https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd513126.docx

USDA Forest Service. 2016c. Rio Grande National Forest – Draft wilderness evaluations. Prepared by Rio Grande National Forest staff, Monte Vista, Colorado. 78 pp plus map. Accessed June 20, 2017, at: https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd521710.pdf

USDA Forest Service Gunnison Service Center (GSC). 2016. 2016 Forest insect and disease conditions, Rio Grande National Forest. Internal report available at Rio Grande National Forest, Monte Vista, Colorado. 6 pp.

Chapter 3. Affected Environment and Environmental Consequences

Air Quality

Colorado Department of Public Health and Environment. 2017. Colorado air quality: Queried sources of air pollution website. Accessed June 21, 2017, at: https://www.colorado.gov/airquality/ss_map_wm.aspx

Interagency Monitoring of Protected Visual Environments. 2017. Website accessed April 10, 2017, at: http://vista.cira.colostate.edu/Improve/

Mast, M.A., D.H. Campbell, and G.P. Ingersoll. 2005. Effects of emission reductions at the Hayden powerplant on precipitation, snowpack, and surface-water chemistry in the Mount Zirkel Wilderness Area, Colorado, 1995–2003. U.S. Geological Survey Scientific Investigations Report 2005–5167, 32 pp.

Musselman, R.C., and J.L. Korfmacher. 2014. Ozone in remote areas of the southern Rocky Mountains. Atmospheric Environment 82:383–390.

Pardo, L.H., M.J. Robin-Abbot, and C.T. Driscoll. 2011. Assessment of nitrogen deposition effects and empirical critical loads of nitrogen for ecoregions of the United States. USDA Forest Service Northern Research Station. General Technical Report NRS-80, 301 pp.

USDA Forest Service. 1994. Rio Grande National Forest, USDA Air Resources Monitoring Plan. 24 pp.

USDA Forest Service. 2011. Watershed condition classification. Technical Guide FS–978, 49 pp. Accessed May 16, 2017, at: https://www.fs.fed.us/biology/resources/pubs/watershed/maps/watershed_classification_guide2011FS978.pdf

USDA Forest Service. 2016. Rio Grande National Forest assessment reports. Prepared by Rio Grande National Forest staff, Monte Vista, Colorado. Accessed May 16, 2017, at: https://www.fs.usda.gov/detailfull/riogrande/landmanagement/projects/?cid=fseprd479245&width=full

USDA Forest Service. 2017. Air quality portal for land management planning. Accessed April 10, 2017, at: http://www.srs.fs.usda.gov/airqualityportal/index.php

U.S. Environmental Protection Agency. 2017a. Air emissions inventories: National emissions inventory (NEI) website. Accessed June 21, 2017, at: https://www.epa.gov/air-emissions-inventories/national-emissions-inventory-nei

U.S. Environmental Protection Agency. 2017b. Ozone trends. Accessed July 21, 2017, at: https://www.epa.gov/air-trends/ozone-trends#ozreg

U.S. Environmental Protection Agency. 2017c. Particulate matter (PM10) trends. Accessed July 21, 2017, at: https://www.epa.gov/air-trends/particulate-matter-pm10-trends#pmreg

Forested Ecosystems

Alexander, K.D., and Keck, A.G. 2015. Uncompahgre fritillary butterfly monitoring and inventory: 2014 report and status. Western State Colorado University, Gunnison, Colorado. 19 pp.

Battaglia, M. 2017a. Impacts and vulnerabilities for forest ecosystem types of the Rio Grande National Forest. USDA Forest Service, Rocky Mountain Research Station. Internal report available at Rio Grande National Forest, Monte Vista, Colorado. 18 pp.

Battaglia, M. 2017b. Review of Rio Grande National Forest 1996 NRV appendix – Forest communities. USDA Forest Service, Rocky Mountain Research Station. Internal report available at Rio Grande National Forest, Monte Vista, Colorado. 4 pp.

Bottero, A., D'Amato, A.W., Palik, B.J., Bradford, J.B., Fraver, S., Battaglia, M.A., and Asherin, L.A. 2016. Density-dependent vulnerability of forest ecosystems to drought. Journal of Applied Ecology. doi:10.1111/1365-2664.12847.

Bradford, J.B., and Bell, D.M. 2016. A window of opportunity for climate-change adaptation: Easing tree mortality by reducing forest basal area. Frontiers in Ecology and the Environment 15:11–17. doi:10.1002/fee.1445.

Colorado Natural Heritage Program. 2015. Tracked natural plant communities. Website accessed May 17, 2017, at: http://www.cnhp.colostate.edu/download/list/communities.asp

Dale, V.H., Joyce, L.A., McNulty, S., Neilson, R.P., Ayres, M.P., Flannigan, M.D., Hanson, P.J., Irland, L.C., Lugo, A.E., Peterson, C.J., Simberloff, D., Swanson, F.J., Stocks, B.J., and Wotton, M. 2001. Climate change and forest disturbances. BioScience 51(9):723–734.

D'Amato, A.W., Bradford, J.B., Fraver, S., and Palik, B.J. 2013. Effects of thinning on drought vulnerability and climate response in north temperate ecosystems. Ecological Applications 23:1735–42.

Delong, S.C., Sutherland, G.D., Daniels, L.D., Heemskerk, B.H., Olaf Storaunet, K. 2008. Temporal dynamics of snags and development of snag habitats in wet spruce-stands in east-central British Columbia. Forest Ecology and Management 255:3613–3620.

Eager, T., Mask, R., and Gray, S. 2012. Biological Evaluation R2-01-12 – Review of forest insect activity on the Rio Grande National Forest from 2000 to 2011. USDA Forest Service, Rocky Mountain Region, Renewable Resources Division. Available in the project record at the U.S. Forest Service, Monte Vista, Colorado.

Holling, C.S. 1973. Resilience and stability of ecological systems. Annual Review of Ecology and Systematics, pp. 41–23.

Hoover, R.L. and Wills, D. 1984. Managing forested lands for wildlife. Colorado Division of Wildlife in cooperation with USDA Forest Service, Rocky Mountain Region. Appendix H – Wildlife Requirements and Uses of Snags and Dead/Down Trees on Forested Lands in Colorado. Pp. 413–417.

Intergovernmental Panel on Climate Change (IPCC). 2014. Climate change 2014 synthesis report summary for policymakers. Accessed June 22, 2017, at: https://www.ipcc.ch/pdf/assessment-report/ar5/syr/AR5_SYR_FINAL_SPM.pdf

Lindenmayer, D.B., Franklin, J.F., and Fischer, J. 2006. General management principles and a checklist of strategies to guide forest biodiversity conservation. Biological Conservation 131(3):433–445.

Mehl, M.S. 1992. Old-growth descriptions for the major forest cover types in the Rocky Mountain Region. *In:* Old Growth Forests in the Southwest and Rocky Mountain Regions. USDA Forest Service General Technical Report RM-213. U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado.

Mielke, J. 1950. Rate of deterioration of beetle-killed Engelmann spruce. Journal of Forestry, 48(12):882–888.

Rocca, M.E., Brown, P.M., MacDonald, L.H., and Carrico, C.M. 2014. Climate change impacts on fire regimes and key ecosystem services in Rocky Mountain forests. Forest Ecology and Management 327:290–305.

Romme, W.H., M.L. Floyd, and D. Hanna. 2009. Historical range of variability and current landscape condition analysis: South central highlands section, southwestern Colorado and northwestern New Mexico. Report produced by the Colorado Forest Restoration Institute at Colorado State University and Region 2 of the U.S. Forest Service.

Rondeau, R., Fink, M., Rodda, G., and Kummel, M. 2012. Treeline monitoring in the San Juan Basin tundra: A pilot project. Report by the Colorado Natural Heritage Program, Colorado State University.

Ryerson, D.E., Swetnam, T.W., and Lynch, A.M. 2003. A tree-ring reconstruction of western spruce budworm outbreaks in the San Juan Mountains, Colorado, U.S.A. Canadian Journal of Forest Research 33:1010–1028.

Sovell, J. 2006. Baca Grande Biological Assessment 2005. Report prepared by the Colorado Natural Heritage Program, Colorado State University, Fort Collins, Colorado.

Swetnam, T.W., and Lynch, A.M. 1989. A tree-ring reconstruction of western spruce budworm history in the southern Rocky Mountains. Forest Science 35(4):962–986.

Talbert, M., Gross, J., Morisette, J., and Talbert, C. 2016. Climate summary for the Rio Grande National Forest. Internal report prepared by USDA Forest Service, Rio Grande National Forest, Monte Vista, Colorado.

Thompson, I., Mackey, B., McNulty, S., and Mosseler, A. 2009. Forest resilience, biodiversity, and climate change. A synthesis of the biodiversity/resilience/stability relationship in forest ecosystems. Secretariat of the Convention on Biological Diversity, Montreal. Technical Series No. 43, 67 pp.

Underhill, J.L., Dickinson, Y., Rudney, A., and Thinnes, J. 2014. Silviculture of the Colorado Front Range landscape restoration initiative. Journal of Forestry 112(5):484–493.

USDA Forest Service. 2004. An evaluation of disturbance events and their potential effects on wildlife species: A supplemental report for the county line vegetation management project. Internal report prepared by the Rio Grande National Forest Conejos Peak Ranger District. Available on request at the Rio Grande National Forest, Monte Vista, Colorado.

USDA Forest Service. 2011. National roadmap for responding to climate change. Prepared by the USDA Forest Service Office of Sustainability and Climate, Washington DC. Accessed May 17, 2017, at: https://www.fs.fed.us/climatechange/pdf/Roadmapfinal.pdf

USDA Forest Service. 2014. Forest plan monitoring and evaluation report, Fiscal year 2013, Rio Grande National Forest, Colorado. Prepared by Rio Grande National Forest staff, Monte Vista, Colorado. Accessed July 18, 2017, at https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprd3832523.pdf

USDA Forest Service. 2016. Rio Grande National Forest assessment reports. Prepared by Rio Grande National Forest staff, Monte Vista, Colorado. Accessed May 16, 2017, at: https://www.fs.usda.gov/detailfull/riogrande/landmanagement/projects/?cid=fseprd479245&width=full

USDA Forest Service Gunnison Service Center (GSC). 2016. 2016 Forest insect and disease conditions, Rio Grande National Forest. Internal report available at Rio Grande National Forest, Monte Vista, Colorado. 6 pp.

van Mantgem, P.J., Stephenson, N.L., Byrne, J.C., Daniels, L.D., Franklin, J.F., Fulé, P.Z., Harmon, M.E., Larson, A.J., Smith, J.M., Taylor, A.H., and Veblen, T.T. 2009. Widespread increase of tree mortality rates in the Western United States. Science 323:521–524.

Vose, J.M., D.L. Peterson, and T. Patel-Weynand (eds.). 2012. Effects of climatic variability and change on forest ecosystems: A comprehensive science synthesis for the U.S. forest sector. General Technical Report PNW-GTR-870, 265 pp. Prepared by USDA Forest Service, Pacific Northwest Research Station, Portland, Oregon. Accessed May 17, 2017, at: https://www.fs.fed.us/pnw/pubs/pnw_gtr870/pnw_gtr870.pdf

Walther, G.R., Post, E., Convey, P., Menzel, A., Parmesan, C., Beebee, T.J.C., Fromentin, J.M., Hoegh-Guldberg, O., and Bairlein, F. 2002. Ecological responses to recent climate change. Nature 416:389–395.

Worrall, J.J., Egeland, L., Eager, T., Mask, R.A., Johnson, E.W., Kemp, P.A., and Shepperd, W.D. 2008. Rapid mortality of *Populus tremuloides* in southwestern Colorado, USA. Forest Ecology and Management 255(3–4):686–696.

Worrall, J.J., Marchetti, S.B., and Rehfeldt, G.E. 2016. Bioclimate models and change projections to inform forest adaptation in southwestern Colorado: Interim Report. Technical Report R2-68. Forest Health Protection.

Fire Management

Baisan, C.H., and T.W. Swetnam. 1997. Interactions of fire regimes and land use in the central Rio Grande valley. USDA Forest Service Research Paper RM–RP–330.

Baker, W.L. 2006. Fire and restoration of sagebrush ecosystems. Wildlife Society Bulletin 34:177–185.

Baker, W.L., and T.T. Veblen. 1990. Spruce beetles and fires in the nineteenth-century subalpine forests of western Colorado. U.S.A. Arctic and Alpine Research 22:65–80.

Barrett, S.W. 1994. Fire regimes on andesitic mountain terrain in northeastern Yellowstone National Park, Wyoming. International Journal of Wildland Fire 4:65–76.

DeByle, N.V., and R.P. Winokur (eds.). 1985. Aspen: Ecology and management in the Western United States. USDA Forest Service General Technical Report RM–119.

Eisenhart, K.S. 2004. Historic range of variability and stand development in piñon–juniper woodlands of western Colorado. PhD dissertation, University of Colorado, Boulder.

Forests and Rangelands. 2017. National cohesive wildland fire management strategy. Joint U.S. Department of the Interior and U.S. Department of Agriculture website, accessed June 23, 2017, at: https://www.forestsandrangelands.gov/strategy/

Fule, P.Z., J.E. Korb, and R. Wu. 2009. Changes in forest structure in a mixed-conifer forest, southwestern Colorado, USA. Forest Ecology and Management 258:1200–1210.

Johnson, E.A., and G.I. Fryer. 1989. Population dynamics in lodgepole pine-Engelmann spruce forests. Ecology 70:1335–1345.

Korb, J.E., P.Z. Fulé, and R. Wu. 2013. Variability of warm/dry mixed conifer forests in southwestern Colorado, USA: Implications for ecological restoration. Forest Ecology and Management 304:182–191.

Kulakowski, D., C. Matthews, D. Jarvis, and T.T. Veblen. 2013. Compounded disturbances in sub-alpine forests in western Colorado favour future dominance by quaking aspen (*Populus tremuloides*). Journal of Vegetation Science 24:168–176.

Lertzman, K.P., and Krebs, C.J. 1991. Gap-phase structure of a subalpine old-growth forest. Canadian Journal of Forest Research 21:1730–1741.

McKenzie D., Peterson, D.L., and Littell, J. 2009. Global warming and stress complexes in forests of western North America. *In:* A. Bytnerowicz, Arbaugh, M.J., Riebau, A.R., and Andersen, C. (eds.). Wildland Fires and Air Pollution, pp. 317–337. Elsevier Publishers, The Hague, Netherlands.

National Interagency Fire Center. 2017. Interagency standards for fire and fire aviation operations. Prepared by the Interagency Standards for Fire and Fire Aviation Operations Group, National Interagency Fire Center, Boise, Idaho. Accessed June 23, 2017, at https://www.nifc.gov/PUBLICATIONS/redbook/2017/RedBookAll.pdf

Peterson, D.L., and J.M. Vose. 2012. Chapter 7 Conclusions. Pages 201–204 *in:* Vose, J.M., D.L. Peterson, and T. Patel-Weynand (eds.). Effects of Climatic Variability and Change on Forest Ecosystems: A Comprehensive Science Synthesis for the U.S. Forest Sector. General Technical Report PNW-GTR-870. USDA Forest Service, Pacific Northwest Research Station, Portland, Oregon.

Romme, W., C. Allen, J. Bailey, W. Baker, B. Bestelmeyer, P. Brown, K. Eisenhart, L. Floyd-Hanna, D. Huffman, B. Jacobs, R. Miller, E. Muldavin, T. Swetnam, R. Tausch, and P. Weisberg. 2008. Historical and modern disturbance regimes of piñon-juniper vegetation in the western U.S. Report published by Colorado Forest Restoration Institute, Colorado State University, Fort Collins, Colorado. Host website accessed July 25, 2017, at: http://www.cfri.colostate.edu/

Romme, W.H., M.L. Floyd, and D. Hanna. 2009. Historical range of variability and current landscape condition analysis: South central highlands section, southwestern Colorado and northwestern New Mexico. Report produced by the Colorado Forest Restoration Institute at Colorado State University and Region 2 of the U.S. Forest Service.

Roovers, L.M., and A.J. Rebertus. 1993. Stand dynamics and conservation of an old growth Engelmann spruce - subalpine fir forest in Colorado. Natural Areas Journal 13:256–267.

Sapsis, D.B., and J.B. Kauffman. 1991. Fuel consumption and fire behavior associated with prescribed fires in sagebrush ecosystems. Northwest Science 65(4):173–179.

Stahelin, R. 1943. Factors influencing the natural re-stocking of high altitude burns by coniferous trees in the central Rocky Mountains. Ecology 24:19–30.

Turner, M.G., W.H. Romme, R.H. Gardner, and W.W. Hargrove. 1997. Effects of fire size and pattern on early succession in Yellowstone National Park. Ecological Monographs 67:411–433.

USDA Forest Service. 2016. Rio Grande National Forest assessment reports. Prepared by Rio Grande National Forest staff, Monte Vista, Colorado. Accessed May 16, 2017, at: https://www.fs.usda.gov/detailfull/riogrande/landmanagement/projects/?cid=fseprd479245&width=full

Veblen, T.T. 2000. Disturbance patterns in southern Rocky Mountain forests. Chapter 2 *in:* Knight, R.L., F.W. Smith, S.W. Buskirk, W.H. Romme, and W.L. Baker (eds.). Forest fragmentation in the southern Rocky Mountains. University Press of Colorado.

Veblen, T.T., K.S. Hadley, E.M. Nel, T. Kitzberger, M. Reid, and R. Villalba. 1994. Disturbance regime and disturbance interactions in a Rocky Mountain subalpine forest. Journal of Ecology 82(1):125–135.

Veblen, T.T., K.S. Hadley, M.S. Reid, and A.J. Rebertus. 1989. Blowdown and stand development in a Colorado subalpine forest. Canadian Journal of Forest Research 19:1218–1225.

Veblen, T.T., K.S. Hadley, M.S. Reid, and A.J. Rebertus. 1991a. The response of subalpine forests to spruce beetle outbreak in Colorado. Ecology 72(1):213–231.

Vose, J.M., D.L. Peterson, and T. Patel-Weynand (eds.). 2012. Effects of climatic variability and change on forest ecosystems: A comprehensive science synthesis for the U.S. forest sector. General Technical Report PNW-GTR-870, 265 pp. Prepared by USDA Forest Service, Pacific Northwest Research Station, Portland, Oregon. Accessed May 17, 2017, at: https://www.fs.fed.us/pnw/pubs/pnw_gtr870/pnw_gtr870.pdf

Westerling, A., T. Brown, T. Schoennagel, T. Swetnam, M. Turner, T. and Veblen. 2014. Briefing: Climate and wildfire in western U.S. forests. *In:* Sample, V. A., Bixler, and R. Patrick (eds.). Forest Conservation and Management in the Anthropocene: Conference proceedings. Proceedings. RMRS–P–71. Fort Collins, Colorado. USDA Forest Service Rocky Mountain Research Station. pp. 81–102.

Whisenant, S.G. 1990. Changing fire frequencies on Idaho's Snake River Plains: Ecological and management implications. *In:* McArthur, E.D., E.M. Romney, S.D. Smith, and P.T. Tueller (eds.). Proceedings—Symposium on Cheatgrass Invasion, Shrub Die-off, and Other Aspects of Shrub Biology and Management. Las Vegas, Nevada, April 5–7, 1989. Ogden, Utah, USDA Forest Service, Intermountain Research Station, General Technical Report INT-276, pp. 4–10.

Whitlock C., Marlon, J., Briles, C., Brunelle, A., Long, C., and Bartlein, P. 2008. Long-term relations among fire, fuel, and climate in the northwestern US based on lake-sediment studies. International Journal of Wildland Fire 17:72–83.

Carbon Stocks and Sequestration

Bachelet, D., Neilson, R.P., Lenihan, J.M., and Drapek, R.J. 2001. Climate change effects on vegetation distribution and carbon budget in the U.S. Ecosystems 4:164–185.

Birdsey, R.A., Jenkins, J.C., Johnston, M., Huber-Saanwald, E., Amero, B., de Jong, B., Barra, J.D.E., French, N., Garcia-Oliva, F., Harmon, M., Heath, L.S., Jaramillo, V.J., Johnsen, K., Law, B.E., Marin-Spiotta, E., Masera, O., Neilson, R., Pan, Y., and Pregitzer, K.S. 2007. North American forests. *In:* King, A.W., Dilling, L., Zimmerman, G.P., Fairman, D.M., Houghton, R.A., Marland, G., Rose, A.Z., and Wilbanks, T.J. (eds.). The First State of the Carbon Cycle Report (SOCCR): The North American Carbon Budget and Implications for the Global Carbon Cycle. National Oceanic and Atmospheric Administration, National Climatic Data Center, Asheville, North Carolina, pp. 117–126.

Boisvenue, C. 2007. Assessing forest responses to climate change and resolving productivity measurements across spatial scales. PhD dissertation. University of Montana Department of Ecosystem and Conservation Sciences, Missoula, Montana. Page 102.

Boisvenue, C., and Running, S. 2010. Simulations show decreasing carbon stocks and potential for carbon emissions for Rocky Mountain forests in the next century. Ecological Applications 20(5):1302–1319.

Canadell J.G., Pataki, D.E., Gifford, R., Houghton, R.A., Lou, Y., Raupach, M.R., Smith, P., and Steffen, W. 2007. Saturation of the terrestrial carbon sink. Pages 59–78 *in:* Canadell, J.G., Pataki, D.E., and Pitelka, L.F. (eds.). Terrestrial Ecosystems in a Changing World. Springer-Verlag Berlin Heidelberg. DOI: 10.1007/978-3-540-32730-1.

Dugan, A.J., Birdsey, R., Healey, S.P., Pan, Y., Zhang, F., Mo, G., Chen, J., Woodall, C.W., Hernandez, A.J., McCullough, K., McCarter, J.B., Raymond, C.L., and Dante-Wood, K. 2017. Forest sector carbon analyses support land management planning and projects: Assessing the Influence of Anthropogenic and Natural Factors. Climatic Change. pp. 1–14. DOI: [10.1007/s10584-017-2038-5](10.1007/s10584-017-2038-5)

Fischlin, A., Midgley, G.F., Price, J.T., Leemans, R., Gopal, B., Turley, C., Rounsevell, M.D.A., Dube, O.P., Tarazona, J., and Velichko, A.A. 2007. Chapter 4: Ecosystems, their properties, goods and services. Pages 211–272 *in:* Intergovernmental Panel on Climate Change – Fourth Assessment Report: Climate Change 2007: Impacts, Adaptation and Vulnerability. Cambridge, UK, Cambridge University Press.

Healey, S.P., Raymond, C.L., Lockman, I.B., Hernandez, A.J., Garrard, C., and Huang, C. 2016. Root disease can rival fire and harvest in reducing forest carbon storage. Ecosphere 7, e01569-n/a.

Healey, S.P., Urbanski, S.P., Patterson, P.L., and Garrard, C. 2014. A framework for simulating map error in ecosystem models. Remote Sensing of Environment 150:207–217.

Hu, J., D.J.P. Moore, S.P. Burns, and R.K. Monson. 2010. Longer growing seasons lead to less carbon sequestration by a subalpine forest. Global Change Biology 16(2):771–783.

Joyce, L.A., and Nungesser, M. 2000. Ecosystem productivity and the impact of climate change. Pages 45-68 i*n:* Joyce, L.A., Birdsey, R. (eds.). The Impact of Climate Change on America's Forests. U.S. Forest Service General Technical Report RMRS-GTR-59, 133 pp. USDA Forest Service, Rocky Mountain Research Station, Fort Collins, Colorado.

King, A.W., et al. 2007. The first state of the carbon cycle report (SOCCR): The North American carbon budget and implications for the global carbon cycle. National Oceanic and Atmospheric Administration, National Climatic Data Center, Asheville, North Carolina. 264 pp. Accessed May 17, 2017, at: http://cdiac.ornl.gov/SOCCR/pdf/sap2-2-final-all.pdf

Kozlowski, T.T., and Pallardy, S.G. 1997. Physiology of woody plants. Biologia Plantarum 40(2):168–168.

Lenihan, J.M., Bachelet, D., Neilson, R.P., and Drapek, R. 2008a. Simulated response of conterminous United States ecosystems to climate change at different levels of fire suppression, CO_2 emission rate, and growth response to CO_2. Global and Planetary Change 64:16–25.

Lenihan, J.M., Bachelet, D., Neilson, R.P., and Drapek, R. 2008b. Response of vegetation distribution, ecosystem productivity, and fire to climate change scenarios for California. Climatic Change 87 (Supplement 1):S215–S230.

Pacala, S.W., Birdsey, R., Bridgham, J., Caspersen, J., Conant, R., Davis, K., Hales, B., Houghton, R., Jenkins, J., Johnson, M., Marland, G., Puastian, K., Socolow, R., Tol, R., and Wofsy, S. 2007. The North American carbon budget past and present. Pages 29–36 *in*: King, A.W., Dilling, L., Zimmerman, G.P., Fairman, D.M., Houghton, R.A., Marland, G., Rose, A.Z., and Wilbanks, T.J. (eds.). The First State of the Carbon Cycle Report (SOCCR): The North American Carbon Budget and Implications for the Global Carbon Cycle. National Oceanic and Atmospheric Administration, National Climatic Data Center, Asheville, North Carolina.

Pan, Y., Birdsey, R.A., Fang, J., Houghton, R., Kauppi, P.E., Kurz, W.A., Phillips, O.L., Shvidenko, A., Lewis, S.L., Canadell, J.G., Ciais, P., Jackson, R.B., Pacala, S.W., McGuire, A.D., Piao, S., Rautiainen, A., Sitch, S., and Hayes, D. 2011. A large and persistent carbon sink in the world's forests. Science 333:988–993.

Raymond, C.L., Healey, S., Peduzzi, A., and Patterson, P. 2015. Representative regional models of post-disturbance forest carbon accumulation: Integrating inventory data and a growth and yield model. Forest Ecology and Management 336:21–34.

Skog, K.E. 2008. Sequestration of carbon in harvested wood products for the United States. Forest Products Journal 58(6):56–72.

Stockmann, K., Anderson, N., Young, J., Skog, K., Healey, S., Loeffler, D., Butler, E., Jones, J.G., and Morrison, J. 2014. Estimates of carbon stored in harvested wood products from U.S. Forest Service Rocky Mountain Region, 1906–2012. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Forestry Sciences Laboratory, Missoula, Montana. Unpublished report, 27 pp.

USDA Forest Service. 2009. Climate change considerations in project level NEPA analysis, January 13, 2009. Accessed June 26, 2017, at: https://www.fs.fed.us/emc/nepa/climate_change/includes/cc_nepa_guidance.pdf

USDA Forest Service. 2010. Climate change considerations in land management plan revisions, January 20, 2010. Accessed June 26, 2017, at: https://www.fs.fed.us/emc/nepa/climate_change/includes/cc_land_mgmt_plan_rev_012010.pdf

USDA Forest Service. 2015. Baseline estimates of carbon stocks in forests and harvested wood products for National Forest System units, Rocky Mountain Region. 54 pp. Accessed May 16, 2017, at:

http://www.fs.fed.us/climatechange/documents/RockyMountainRegionCarbonAssessmentTwoBaselines.pdf

USDA Forest Service. 2016a. Assessment of the influence of disturbance, management activities, and environmental factors on carbon stocks, Rocky Mountain Region (draft). Prepared by USDA Forest Service Office of Sustainability and Climate Change, Washington DC. 74 pp.

USDA Forest Service. 2016b. Rio Grande National Forest assessment reports. Prepared by Rio Grande National Forest staff, Monte Vista, Colorado. Accessed May 16, 2017, at: https://www.fs.usda.gov/detailfull/riogrande/landmanagement/projects/?cid=fseprd479245&width=full

U.S. Environmental Protection Agency. 2013. Inventory of U.S. greenhouse gas emissions and sinks: 1990–2011. EPA 430-R-13-001. Accessed August 15, 2017, at: https://www.epa.gov/sites/production/files/2015-12/documents/us-ghg-inventory-2013-main-text.pdf

van Mantgem, P.J., Stephenson, N.L., Byrne, J.C., Daniels, L.D., Franklin, J.F., Fulé, P.Z., Harmon, M.E., Larson, A.J., Smith, J.M., Taylor, A.H., and Veblen, T.T. 2009. Widespread increase of tree mortality rates in the Western United States. Science 323:521–524.

Vose, J.M., D.L. Peterson, and T. Patel-Weynand (eds.). 2012. Effects of climatic variability and change on forest ecosystems: A comprehensive science synthesis for the U.S. forest sector. General Technical Report PNW-GTR-870, 265 pp. Prepared by USDA Forest Service, Pacific Northwest Research Station, Portland, Oregon. Accessed May 17, 2017, at: https://www.fs.fed.us/pnw/pubs/pnw_gtr870/pnw_gtr870.pdf

Forest Products

Colorado State Forest Service. 2009. Colorado statewide forest resource assessment: A foundation for strategic discussion and implementation of forest management in Colorado. Accessed May 17, 2017, at: http://static.colostate.edu/client-files/csfs/pdfs/SFRA09_csfs-forestassess-web-bkmrks.pdf

Forest Stewardship Concepts, Ltd. 2014. Rio Grande Basin watershed health and forest biomass opportunities evaluation. Report prepared for the Rio Grande Watershed Emergency Action Coordination Team. 28 pp.

Nonforested Ecosystems

USDA Forest Service. 1996. Final Environmental Impact Statement for the Revised Land and Resource Management Plan. Rio Grande National Forest, Monte Vista, Colorado.

Romme, W.H., M.L. Floyd, and D. Hanna. 2009. Historical range of variability and current landscape condition analysis: South central highlands section, southwestern Colorado and northwestern New Mexico. Report produced by the Colorado Forest Restoration Institute at Colorado State University and Region 2 of the U.S. Forest Service.

Range Management

USDA Forest Service. 1996. Final Environmental Impact Statement for the Revised Land and Resource Management Plan. Rio Grande National Forest, Monte Vista, Colorado.

Aquatic and Terrestrial Nonnative Invasive Species

Colorado Department of Agriculture. 2017. Noxious weed FAQs. Webpage accessed June 26, 2017, at: https://www.colorado.gov/pacific/agconservation/noxious-weed-faqs

Colorado Parks and Wildlife. 2017. Top invasive concerns: Rusty crayfish. Webpage accessed June 27, 2017, at: http://cpw.state.co.us/rustycrayfish

National Wildfire Coordinating Group. 2017. Guide to preventing aquatic invasive species transport by wildland fire operations. PMS 444. Available at: https://www.nwcg.gov/publications/444

USDA Forest Service. 2017. USDA Forest Service aerial fire retardant avoidance viewer. Accessed May 16, 2017, at: https://usfs.maps.arcgis.com/apps/webappviewer/index.html?id=53c2f30ed89f429b93f2e09dc3336ad0.

Geologic Hazards

USDA Forest Service. 2016. Rio Grande National Forest assessment reports. Prepared by Rio Grande National Forest staff, Monte Vista, Colorado. Accessed May 16, 2017, at: https://www.fs.usda.gov/detailfull/riogrande/landmanagement/projects/?cid=fseprd479245&width=full

Renewable and Non-renewable Energy and Minerals

USDA Forest Service. 2016. Rio Grande National Forest assessment reports. Prepared by Rio Grande National Forest staff, Monte Vista, Colorado. Accessed May 16, 2017, at: https://www.fs.usda.gov/detailfull/riogrande/landmanagement/projects/?cid=fseprd479245&width=full

Soils

Ganjegunte, G.K., L.M. Condron, P.W. Clinton, M.R. Davis, and N. Mahieu. 2003. Decomposition and nutrient release from radiate pine (*pinus radiate*) coarse woody debris. Forest Ecology and Management 187 (2004) 197–211.

Jurgensen, M.F., A.E. Harvey, R.T. Graham, D.S. Page-Dumroese, J.R. Tonn, M.J. Larsen, and T.B. Jain. 1997. Impacts of timber harvesting on soil organic matter, nitrogen, productivity, and health of the inland northwest forests. Forest Science 43(2):234–251.

Laiho, R., and C.E. Prescott. 2004. Decay and nutrient dynamics of coarse woody debris in northern coniferous forests: A synthesis. Canadian Journal of Forest Research 34:763–777.

Steuer, J.J. 2010. A generalized watershed disturbance-invertebrate relation applicable in a range of environmental settings across the continental United States. Urban Ecosystems 13(4):415.

Stoof, C.R., D. Moore, P.M. Fernandes, J.J. Stoorvogel, R.E.S. Fernandes, A.J.D. Ferreira, and C.J. Ritsema. 2013. Hot fire, cool soil. Geophysical Research Letters 40:1534–1539.

USDA Forest Service. 1996. Final Environmental Impact Statement for the Revised Land and Resource Management Plan. Rio Grande National Forest, Monte Vista, Colorado.

USDA Forest Service. 2016. Rio Grande National Forest assessment reports. Prepared by Rio Grande National Forest staff, Monte Vista, Colorado. Accessed May 16, 2017, at: https://www.fs.usda.gov/detailfull/riogrande/landmanagement/projects/?cid=fseprd479245&width=full

USDA Natural Resources Conservation Service. 1996. Soil resource and ecological inventory of the Rio Grande National Forest – west part, Colorado. Available through the website hosting published soil surveys for Colorado at: http://www.nrcs.usda.gov/wps/portal/nrcs/surveylist/soils/survey/state/?stateId=CO

Williams, J.R., and W.A. Nielson. 2000. The influence of site on rate and extent of soil compaction and profile disturbance of skid trails during ground-based harvesting. Canadian Journal of Forest Research 30:1196–1205.

Aquatic Ecosystems

Alves, J.E., K.A. Patten, D.E. Brauch, and P.M. Jones. 2008. Rangewide status of Rio Grande cutthroat trout (*Oncorhynchus clarkii virginalis*). Rio Grande Cutthroat Trout Conservation Team Report. Colorado Parks and Wildlife, Fort Collins, Colorado.

Barnett, T.P., D.W. Pierce, H.G. Hidalgo, C. Bonfils, B.D. Santer, T. Das, G. Bala, A.W. Wood, T. Nozawa, A.A. Mirin, D.R. Cayan, and M.D. Dettinger. 2008. Human-induced changes in the hydrology of the Western United States. Science 319:1080–83. Accessed May 11, 2017, at: http://tenaya.ucsd.edu/~dettinge/barnett08.pdf

Bestgen, K.R., R.I. Compton, K.A. Zelasko, and J.E. Alves. 2003. Distribution and status of Rio Grande chub in Colorado. Final report to the Colorado Division of Wildlife, Fort Collins, Colorado. Larval Fish Laboratory Contribution 135. 61 pp.

Collen, P., and Gibson, R.J. 2001. The general ecology of beavers (*Castor* spp.), as related to their influence on stream ecosystems and riparian habitats, and the subsequent effects of fish – A review. Reviews in Fish Biology and Fisheries. 10:439–461.

Cooper, D.J. 1990. Ecology of wetlands in Big Meadows, Rocky Mountain National Park, Colorado. U.S. Fish and Wildlife Service Biological Report 90(15). 52 pp.

Cooper, D.J. 2005. Analysis of the Strawberry Lake fen complex, Arapaho National Forest, Colorado. Unpublished report prepared for the U.S. Forest Service, Fort Collins, Colorado. Department of Forest, Rangeland, and Watershed Stewardship, Colorado State University, Fort Collins, Colorado.

Galindo, R., W.D. Wilson, and C.A. Caldwell. 2016. Geographic distribution of genetic diversity in populations of Rio Grande Chub *Gila pandora*. Conservation Genetics 17:1081–1091. doi:10.1007/s10592-016-0845-2.

Fuller, P. 2017. *Gila pandora*. U.S. Geological Survey nonindigenous aquatic species database, Gainesville, FL. Website accessed May 16, 2017, at: https://nas.er.usgs.gov/queries/FactSheet.aspx?speciesID=541.

Furniss, M.J., T.D. Roelofs, and C.S. Yee. 1991. Road construction and maintenance. Pages 297–323 *in:* W.R. Meehan (ed.). Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats. American Fisheries Society, Special Publication 19.

Grace III, J.M., and B.D. Clinton. 2007. Protecting soil and water in forest road management. American Society of Agricultural and Biological Engineers 50(5):1579–1584.

Gucinski, H., M.J. Furniss, R.R. Ziemer, and M.H. Brookes. 2001. Forest roads: A synthesis of scientific information. USDA Forest Service Pacific Northwest Research Station, Portland, Oregon. General Technical Report PNW-GTR-509. Accessed May 16, 2017, at: http://www.fs.fed.us/pnw/pubs/pnw_gtr509.pdf

Hagglund, A., and G. Sjoberg. 1999. Effects of beaver dams on fish fauna of forest streams. Forest Ecology and Management 115:259–266.

Hubbs, C., R.J. Edwards, and G.P. Garrett. 2008. An annotated checklist of the freshwater fishes of Texas, with keys to identification of species. Texas Academy of Science. Available from: http://www.texasacademyofscience.org/

Inland Cutthroat Trout Viewer. 2016. Website accessed May 16, 2017, at: http://icp.wygisc.org/

Isaak, D.J., Luce, C.H., Rieman, B.E., Nagel, D.E., Peterson, E.E., Horan, D.L., and Chandler, G.L. 2010. Effects of climate change and wildfire on stream temperatures and salmonid thermal habitat in a mountain river network. Ecological Applications, 20(5):1350–1371. doi:10.1890/090822.1.

Isaak, D.J., Young, M.K., Nagel, D.E., Horan, D.L., and Groce, M.C. 2015. The cold-water climate shield: Delineating refugia for preserving salmonid fishes through the 21st century. Global Change Biology 21(7):2540–2553. doi:10.1111/gcb.12879.

Jones, P. 2017. 2016 Aquatic conservation inventory report. South West Region, Colorado Parks and Wildlife. 78 pp.

Lake, P. S. 2000. Disturbance, patchiness, and diversity in streams. Journal of the North American Benthological Society 19(4):573–592.

Lee, D.C., Sedell, J.R., Rieman, B.F., Thurow, R.F., and Williams, J.E. 1997. Broadscale assessment of aquatic species and habitats. Chapter 4 *in:* T.M. Quigley and S.J. Arbelbide (eds.). An Assessment of Ecosystem Components in the Interior Columbia Basin and Portions of the Klamath and Great Basins, Vol. 1. General Technical Report PNW-405, pp. 1058–1496. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Portland, Oregon.

MacDonald, L.H., and J.D. Stednick. 2003. Forests and water: A state-of-the-art review for Colorado. Colorado Water Resources Research Institute (CWRRI) Completion Report No. 196. Colorado State University, Fort Collins, Colorado. Accessed July 25, 2017, at: http://www.fs.fed.us/rm/pubs_exp_forests/manitou/rmrs_2003_macDonald_l001.pdf

Naiman, R.J., J.M. Melillo, and J.E. Hobbie. 1986. Ecosystem alteration of boreal forest streams by beaver (*Castor canadensis*). Ecology 67:1254–1269.

Naiman, R.J., C.A. Johnson, and J.C. Kelley. 1988. Alteration of North American streams by beaver. Bioscience 38:753-762.

National Wildfire Coordinating Group. 2017. Guide to preventing aquatic invasive species transport by wildland fire operations. PMS 444. Available at: https://www.nwcg.gov/publications/444

New Mexico Department of Game and Fish. 2016. State wildlife action plan for New Mexico. New Mexico Department of Game and Fish. Santa Fe, New Mexico.

Olson, R., and W.A. Hubert. 1994. Beaver: Water resources and riparian habitat manager. University of Wyoming, Laramie.

Platts, W.S. 1991. Livestock grazing. Pages 389–423 *in:* W.R. Meehan (ed.). Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats. American Fisheries Society Special Publication 19. American Fisheries Society, Bethesda, Maryland.

Poff, B., K.A. Koestner, D.G. Neary, and V. Henderson. 2011. Threats to riparian ecosystems in Western North America: An analysis of existing literature. Journal of the American Water Resources Association 47(6)1241–1254. doi:10.1111/j.1752-1688.2011.00571.x.

Pritchard, V.L., and D.E. Cowley. 2006. Rio Grande cutthroat trout (*Oncorhynchus clarkii virginalis*): A technical conservation assessment. Species Conservation Project, prepared for the USDA Forest Service, Rocky Mountain Region, 74 pp.

Pyne, M.I., and N.L. Poff. 2016. Vulnerability of stream community composition and function to projected thermal warming and hydrologic change across ecoregions in the Western United States. Global Change Biology: doi:10.1111/gcb.13437.

Reeves, G.H., L.E. Benda, K.M. Burnett, P.A. Bisson, and J.R. Sedell. 1995. A disturbance-based ecosystem approach to maintaining and restoring freshwater habitats of evolutionary significant units of anadromous salmonids in the Pacific Northwest. Part Five: Ecosystems and habitat. *In:* J.L. Nielsen and D.A. Powers (eds.). Symposium 17: Proceedings of the Symposium on Evolution and the Aquatic Ecosystem: Defining Unique Units in Population Conservation, held at Monterey, California, May 23–25, 1994. American Fisheries Society, Bethesda, Maryland.

Reeves, G.H., J.E. Williams, K.M. Burnett, and K. Gallo. 2006. The aquatic conservation 38 strategy of the northwest forest plan. Conservation Biology 20(2):319–329.

Reiter, M., J.T. Heffner, S. Beech, T. Turner, and R.E. Bilby. 2009. Temporal and spatial turbidity patterns over 30 years in a managed forest of western Washington. Journal of the American Water Resources Association. doi: 10.1111/j.1752-1688.2009.00323x.

Rio Grande Cutthroat Trout Conservation Team. 2013. Rio Grande Cutthroat Trout (*Oncorhynchus clarkii virginalis*) Conservation Strategy. 64 pp. Accessed May 16, 2017, at: https://cpw.state.co.us/Documents/Research/Aquatic/CutthroatTrout/2013RGCTConservationStrategy.pdf

Scurlock, D. 1998. From the Rio to the Sierra: An environmental history of the middle Rio Grande basin. USDA Forest Service General Technical Report: RMRS-GTR-5. USDA Forest Service, Rocky Mountain Research Station, Fort Collins, Colorado. 440 pp. Accessed May 16, 2017, at: https://pdfs.semanticscholar.org/f356/04ef687e71afd3eee0eb70f816d906929279.pdf

Silins, U., K.D. Blandon, E.N., Kelly, E. Esch, J.R. Spence, M. Stone, M.B. Emelko, S. Boon, M.J. Wagner, C.H.S. Williams, and I. Tichkowsky. 2014. Five-year legacy of wildfire and salvage logging impacts on nutrient runoff and aquatic plant, invertebrate, and fish productivity. Ecohydrology 7(6):1508–1523. doi:10.1002/eco.1474.

Swift-Miller, S.M., B.M. Johnson, R.T. Muth, and D. Langlois. 1999. Distribution, abundance, and habitat use of Rio Grande sucker (*Catostomus plebeius*) in Hot Creek, Colorado. Southwestern Naturalist 44:42–48.

Rees, D.E., R.J. Carr, and W.J. Miller. 2005. Rio Grande chub (*Gila pandora*): A technical conservation assessment. Species Conservation Project, prepared for the USDA Forest Service, Rocky Mountain Region, 23 pp. Accessed May 16, 2017, at: https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5200374.pdf

Rees, D.E., and W.J. Miller, 2005. Rio Grande sucker (*Catostomus plebeius*): A technical conservation assessment. Species Conservation Project, prepared for the USDA Forest Service, Rocky Mountain Region, 27 pp. Accessed May 16, 2017, at: https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5206797.pdf

Rocchio, J., 2006. Rocky Mountain subalpine-montane fen ecological system, ecological integrity assessment, Colorado Natural Heritage Program.

Stanley, E.H., S.M. Powers, and N.R. Lottig. 2010. The evolving legacy of disturbance in stream ecology: concepts, contributions, and coming challenges. Journal of the North American Benthological Society, 29(1):67–83. https://st3powers.files.wordpress.com/2015/09/2010_jnabs_stanley_et_al.pdf

Sublette, J.E., M.D. Hatch, and M. Sublette. 1990. The fishes of New Mexico. University of New Mexico Press, Albuquerque. 393 pp.

Thomas, J.W., J.F. Franklin, J. Gordon, and K.N. Johnson. 2006. The northwest forest plan: 23 origins, components, implementation experience, and suggestions for change. 24 Conservation Biology 20:277–287.

Trombulak, S.C., and C.A. Frissell. 2000. Review of ecological effects of roads on terrestrial and aquatic communities. Conservation Biology 14(1):18-30. doi:10.1046/j.1523-1739.2000.99084.x.

USDA Forest Service. 2016. Rio Grande National Forest assessment reports. Prepared by Rio Grande National Forest staff, Monte Vista, Colorado. Accessed May 16, 2017, at: https://www.fs.usda.gov/detailfull/riogrande/landmanagement/projects/?cid=fseprd479245&width=full

USDA Forest Service. 2017. USDA Forest Service aerial fire retardant avoidance viewer. Accessed May 16, 2017, at: https://usfs.maps.arcgis.com/apps/webappviewer/index.html?id=53c2f30ed89f429b93f2e09dc3336ad0.

U.S. Bureau of Reclamation. 2011. SECURE Water Act Section 9503(c) - Reclamation Climate Change and Water Report to Congress. 2011. U.S. Department of the Interior, Bureau of Reclamation, Office of Policy and Administration, Denver, Colorado.

U.S. Fish and Wildlife Service. 2014a. Species status assessment report for the Rio Grande cutthroat trout. Albuquerque, New Mexico. 56 pp.

U.S. Fish and Wildlife Service. 2014b. Endangered and threatened wildlife and plants; 12-month finding on a petition to list Rio Grande cutthroat trout as an endangered or threatened species. 50 CFR Part 17: Docket No. FWS–R2–ES–2014–0042; 4500030113.

U.S. Fish and Wildlife Service. 2016. Endangered and threatened wildlife and plants; 90-day finding on a petition to list Rio Grande chub as an endangered or threatened species. 50 CFR Part 17: Docket No. FWS–R2–ES-2016–0019–0001.

Windell, J.T., B.E. Williard, D.J. Cooper, S.Q. Foster, C.F. Knud-Hansen, L.P. Rink, and G.N. Kiladis. 1986. An ecological characterization of Rocky Mountain montane and subalpine wetlands. U.S. Fish and Wildlife Service Biological Report 86(11).

Wohl, E.E. 2001. Virtual rivers: Lessons from the mountain rivers of the Colorado Front Range. Yale University Press, New Haven, Connecticut. 210 p.

Yount, J.D., and Niemi, G.J. 1990. Recovery of lotic communities and ecosystems from disturbance – A narrative review of case studies. Environmental Management 14(5)547–569.

Watershed Resources

Carlson, J. 2008. Potential risks and impacts to soil and water resources from mountain pine beetle mortality: Treatments and wildfire in Colorado and Wyoming national forests. Internal document, USDA Forest Service, Rocky Mountain Region. 40 pp.

Clow, D.W. 2010. Changes in the timing of snowmelt and streamflow in Colorado: A response to recent warming. Journal of Climate 23:2293–2306.

Harpold, A., Brooks, P., Rajagopal, S., Heidbuchel, I., Jardine, A., and Stielstra, C. 2012. Changes in snowpack accumulation and ablation in the intermountain west. Water Resources Research. 48(11). W11501, DOI:10.1029/2012WR011949.

Lute, A.C., Abatzoglou, J.T., and Hegewisch, K.C. 2015. Projected changes in snowfall extremes and interannual variability of snowfall in the Western United States. Water Resources Research. 51(2): 960-972.

Megahan, W., and W. Kidd. 1972. Effects of logging and logging roads on erosion and sediment deposition from steep terrain. Journal of Forestry 70(3):136–141.

MacDonald, L.H., and J.D. Stednick. 2003. Forests and water: A state-of-the-art review for Colorado. Colorado Water Resources Research Institute (CWRRI) Completion Report No. 196. Colorado State University, Fort Collins, Colorado. Accessed July 25, 2017, at: http://www.fs.fed.us/rm/pubs_exp_forests/manitou/rmrs_2003_macDonald_l001.pdf

PRISM Climate Group. 2017. PRISM climate data. Website accessed March 15, 2017, at: http://prism.oregonstate.edu

Reid, L., and T. Dunne. 1984. Sediment production from forest road surfaces. Water Resources Research 20(1):61–78.

Scalzitti, J., Strong, C., and Kochanski, A. 2016. Climate change impact on the roles of temperature and precipitation in western U.S. snowpack variability. Geophysical Research Letters. 43:5361–5369. DOI:10.1002/2016GL068798.

State of Colorado. 2000. Findings of fact, conclusions of law, and judgement and decree concerning the application for water rights of the United States of America in Alamosa, Archuleta, Conejos, Hinsdale, Mineral, Rio Grande, Saguache, Costilla, and San Juan Counties, Colorado. Case No. 81-CW-183. State of Colorado District Court, Water Division No. 3, March 30, 2000.

Swift, L.W., Jr. 1984. Gravel and grass surfacing reduces soil loss from mountain roads. Forest Science. 30(3): 657-670.

Troendle, C.A., and G.S. Bevenger. 1996. Effect of fire on streamflow and sediment transport, Shoshone National Forest, Wyoming. *In:* Greenlee, J.M. (ed.). The Ecological Implications of Fire in Greater Yellowstone. Second Biennial Conference on the Greater Yellowstone Ecosystem, September 17–21, 1993, Yellowstone National Park, Wyoming. Fairfield, Washington: International Association of Wildland Fire: 139 pp.

USDA Forest Service. 2016. Rio Grande National Forest assessment reports. Prepared by Rio Grande National Forest staff, Monte Vista, Colorado. Accessed May 16, 2017, at: https://www.fs.usda.gov/detailfull/riogrande/landmanagement/projects/?cid=fseprd479245&width=full

USDA Forest Service. 1980. An approach to water resources evaluation of non-point silvicultural sources (a procedural handbook). U.S. Environmental Protection Agency, Environmental Research Laboratory, Athens, Georgia. EPA-600/8-80-012. 861 pp.

USDA Forest Service. 2006. Forest Service Handbook 2509.25: Watershed Conservation Practices Handbook, Chapter 10, Management Measures and Design Criteria. Denver: U.S. Department of Agriculture. U.S. Forest Service. Rocky Mountain Region (Region 2).

USDA Forest Service. 2012. Forest Service Technical Guide FS990-A: National best management practices for water quality management on national forest lands, Volume 1: National Corp BMP Technical Guide. 165 pp.

Wenger, S.J., Luce, C.H., Hamlet, A.F., Isaak, D.J., and Neville, H.M. 2010. Macroscale hydrologic modeling of ecologically relevant flow metrics. Water Resources Research, 46:W09513.

Riparian, Wetlands, and Fens

Clow, D.W. 2010. Changes in the Timing of Snowmelt and Streamflow in Colorado: A Response to Recent Warming. Journal of Climate, V.23, pp. 2293-2306.

Harpold, A., Brooks, P., Rajagopal, S., Heidbuchel, I., Jardine, A., and Stielstra, C. 2012. Changes in snowpack accumulation and ablation in the intermountain west. Water Resources Research. 48(11). W11501, DOI:10.1029/2012WR011949.

Hill, R., and C.M. Pickering. 2009. Differences in the resistance of three subtropical vegetation types to experimental trampling. Journal of Environmental Management 90:1305–1312.

Ludwig, F., and M. Moench. 2009. The impacts of climate change on water. Pages 35–50 i*n:* Ludwig, F., Kabat, P., van Schaik, H., and van der Valk, M. (eds.). Climate Change Adaptation in the Water Sector. London: Earthscan Publishing.

Lute, A.C., Abatzoglou, J.T., and Hegewisch, K.C. 2015. Projected changes in snowfall extremes and interannual variability of snowfall in the Western United States. Water Resources Research. 51(2): 960-972.

Scalzitti, J., Strong, C., and Kochanski, A. 2016. Climate change impact on the roles of temperature and precipitation in western U.S. snowpack variability. Geophysical Research Letters. 43:5361–5369. DOI:10.1002/2016GL068798.

State of Colorado. 2000. Findings of fact, conclusions of law, and judgement and decree concerning the application for water rights of the United States of America in Alamosa, Archuleta, Conejos, Hinsdale, Mineral, Rio Grande, Saguache, Costilla, and San Juan Counties, Colorado. Case No. 81-CW-183. State of Colorado District Court, Water Division No. 3, March 30, 2000.

USDA Forest Service. 2016. Rio Grande National Forest assessment reports. Prepared by Rio Grande National Forest staff, Monte Vista, Colorado. Accessed May 16, 2017, at: https://www.fs.usda.gov/detailfull/riogrande/landmanagement/projects/?cid=fseprd479245&width=full

Wildlife and Plant Species

Alexander, K.D. 2009. Unpublished data submitted via e-mail to Terry Ireland on 2008 about prior year Uncompahgre fritillary butterfly calculated abundance. February 18, 2009. 1 p.

Alexander, K.D., and Keck, A.G. 2015. Uncompahgre fritillary butterfly monitoring and inventory: 2014 report and status. Western State Colorado University, Gunnison, Colorado. 19 pp.

Alexander, K.D., and Keck, A.G. 2016. Uncompahgre fritillary butterfly monitoring and inventory: 2015 report and status. Western State Colorado University, Gunnison, Colorado.

Alexander, K.D., and Keck, A.G. 2017. Uncompahgre fritillary butterfly monitoring and inventory: 2016 report and status. Western State Colorado University, Gunnison, Colorado.

Andrews, R., and R. Righter. 1992. Colorado birds. Denver Museum of Natural History. 442 pp.

Aubry, K.B., G.M. Koehler, and J.R. Squires. 2000. Ecology of Canada lynx in southern boreal forests. Pages 373–396 *in:* L.F. Ruggiero, K.B. Aubry, S.W. Buskirk, G.M. Koehler, C.J. Krebs, K.S. McKelvey, and J.R. Squires (eds.). Ecology and Conservation of Lynx in the United States. University Press of Colorado, Boulder, Colorado.

Bailey, A.M., and R.J. Niedrach. 1965. Birds of Colorado. Denver Museum of Natural History. 895 pp.

Beason, J.P. 2009. Yellow-billed cuckoos in western Colorado. Technical Report R-YBCU CDOW & USFWS-08-1. Rocky Mountain Bird Observatory, Brighton, Colorado. 27 pp.

Bebi, P., D. Kulakowski, and T.T. Veblen. 2003. Interactions between fire and spruce beetles in a subalpine Rocky Mountain forest landscape. Ecology 84(2):362–371.

Bird Conservancy of the Rockies. 2017. Rocky Mountain avian data center. Accessed May 2016 through May 19, 2017 at: http://rmbo.org/v3/avian/ExploretheData.aspx

Bull, E.L., C.G. Parks, and T.R. Torgersen. 1997. Trees and logs important to wildlife in the interior Colombia River Basin. General Technical Report PNW-GTR-391. U.S. Forest Service Pacific Northwest Research Station. 55 pp.

Buskirk, S.W., L.F. Ruggiero, K.B. Aubry, D.E. Pearson, J.R. Squires, and K.S. McKelvey. 2000. Comparative ecology of lynx in North America. Pages 397–417 *in:* L.F. Ruggiero, K.B. Aubry, S.W. Buskirk, S.W., G.M. Koehler, C.J. Krebs, K.S. McKelvey, and J.R. Squires (eds.). Ecology and Conservation of Lynx in the United States. University Press of Colorado, Boulder.

Colorado Natural Heritage Program. 2017. Website accessed June 29, 2017, at: http://www.cnhp.colostate.edu/

Colorado Parks and Wildlife. 2015. Wolverines (online fact sheet and information). Accessed threatened and endangered species profiles webpage July 19, 2017 at: http://cpw.state.co.us/learn/Pages/SpeciesProfiles.aspx.

Colorado Parks and Wildlife. 2016a. Deer 2015 post hunt population and sex ratio estimates. 1 page.

Colorado Parks and Wildlife. 2016b. Elk 2015 post hunt population and sex ratio estimates. 1 page.

Colorado Parks and Wildlife. 2016c. Moose 2015 post hunt population estimates.

Colorado Parks and Wildlife. 2016d. 2014-2015 lion harvest, hunter and recreation days for all seasons. 5 pp.

Colorado Parks and Wildlife. 2017a. Success of the lynx reintroduction program. Webpage accessed July 19, 2017, at: http://cpw.state.co.us/learn/Pages/SOC-LynxResearch.aspx

Colorado Parks and Wildlife. 2017b. Colorado Rocky Mountain bighorn sheep 2016 posthunt population estimates – Final 12/28/2016. 2 pp.

Colorado Parks and Wildlife. 2017c. 2016 bear harvest, hunters and recreation days for all manners of take. 10 pp.

Colorado State Forest Service. 2014. 2014 Colorado forest insect and disease update: A supplement to the 2014 report on the health of Colorado's forests. Accessed July 25, 2017, at: https://webcms.colostate.edu/csfs/media/sites/22/2015/03/Final-2014-Insect-Disease-Update-2March2015.pdf

Corn, P.S., and J.C. Fogleman. 1984. Extinction of montane populations of the northern leopard frog (*Rana pipiens*) in Colorado. Journal of Herpetology 18:147–152.

Cousineau, M., and K. Rogers. 1991. Observations on sympatric *Rana pipiens*, *R. blairi*, and their hybrids in eastern Colorado. Journal of Herpetology 25:114–116.

Eager, T., Mask, R., and Gray, S. 2012. Biological Evaluation R2-01-12 – Review of forest insect activity on the Rio Grande National Forest from 2000 to 2011. USDA Forest Service, Rocky Mountain Region, Renewable Resources Division. Available in the project record at the U.S. Forest Service, Monte Vista, Colorado.

eBird. 2017a. Explore hotspots (map/database web application), Accessed on May 19, 2017 at: http://ebird.org/ebird/hotspots

eBird. 2017b. eBird range map (map/database web application), Accessed on May 19, 2017 at: http://ebird.org/ebird/map/

Fischer, J., Lindenmayer, D.B., and Fazey, I. 2004. Appreciating ecological complexity: Habitat contours as a conceptual landscape model. Conservation Biology 18:1245–1253.

George, J.L., R. Kahn, M.W. Miller, and B. Watkins. 2009. Colorado bighorn sheep management plan, 2009–2019. Special Report Number 81, Colorado Division of Wildlife, Terrestrial Resources. Denver, Colorado. 83 pp. plus appendices.

Ghormley, R. 2015. Southwestern willow flycatcher and Mexican spotted owl survey and status report, 2014 field seasons. Unpublished Report. Rio Grande National Forest. 11p.

Gunnison Sage-Grouse Rangewide Steering Committee. 2005. Gunnison sage-grouse rangewide conservation plan. Colorado Division of Wildlife, Denver, Colorado. 359 pp. plus appendices.

Hafner, D.J., K.E. Peterson, and T.L. Yates. 1981. Evolutionary relationships of jumping mice (genus *Zapus*) of the southwestern United States. Journal of Mammalogy 62:501–512.

Hammerson, G.A. 1982. Bullfrog eliminating leopard frogs in Colorado? Herpetological Review 13:115-116.

Haufler, J.B. 1999. Strategies for conserving terrestrial biological diversity. Chap. 2, pp. 17–30 *in:* Baydack, R.K., Campa, H., III and Haufler, J.B. (eds.). Practical Approaches to the Conservation of Biological Diversity. Island Press: Covelo, California.

Hodgson, J.A., C.D. Thomas, B.A. Wintle, and A. Moilanen. 2009. Climate change, connectivity and conservation decision-making: Back to basics. Journal of Applied Ecology 46:964–969.

Intermountain Region Herbarium Network. 2015. Collections Searched for Specimens Collected on or near Rio Grande National Forest, results downloaded in spreadsheet format on August 20, 2015, from: http://intermountainbiota.org/portal/collections/index.php?catid=1

Ivan, J. 2011. Putative Canada lynx (*Lynx canadensis*) movements across Hwy 114 near North Pass, Colorado. Colorado Division of Wildlife report.

Ivan, J. 2017. PowerPoint presentation to Rio Grande National Forest staff, February 22, 2017.

Johnson, C.L. 1997. Distribution, habitat, and ecology of the Mexican spotted owl in Colorado. M.S. thesis, University of Northern Colorado, Greeley, Colorado.

Jones, C.A. 1999. *Zapus hudsonius* in southern Colorado. Occasional paper: Museum of Texas Tech University 191:1–7.

Kindscher, K., Martin, L.M., Long, Q., Craft, R., Loring, H., Sharaf, M.H., and Yang, J. 2017. Harvesting and recolonization of wild populations of oshá (*Ligusticum porteri*) in southern Colorado. Natural Areas Journal 37(2)178–187.

Krausman, P.R., and R.T. Bowyer. 2003. Mountain sheep. Pages 1095–1115 *in:* Feldhamer, G.A., B.C. Thompson, and J.A. Chapman (eds.). Wild Mammals of North America. The John Hopkins University Press, Baltimore, Maryland.

Landres, P.B., P. Morgan, and F.J. Swanson. 1999. Overview of the use of natural variability concepts in managing ecological systems. Ecological Applications. 9:1179–1188.

Lesica, P., and B. McCune. 2004. Decline of arctic-alpine plants at the southern margin of their range following a decade of climatic warming. The Journal of Vegetation Science. 15(5):697–690.

Martin, K., A. Norris, and M. Drever. 2006. Effects of bark beetle outbreaks on avian biodiversity in the British Columbia interior: Implications for critical habitat management. BC Journal of Ecosystems and Management 7(3):10–24.

Maze, R. 2013. Fresh tracks and the Canada lynx. Elevation Outdoors website. Accessed April 20, 2017, at: http://www.elevationoutdoors.com/fresh-tracks-and-the-canada-lynx/

McDonald, C.B., J. Anderson, J.C. Lewis, R. Mesta, A. Ratzlaff, T.J. Tibbitts, and S.O. Williams. 1991. Mexican spotted owl (*Strix occidentalis lucida*) status report. U.S. Fish and Wildlife Service, Albuquerque, New Mexico, USA.

Merrill, G. 2005. Colorado lynx den site habitat. Colorado Division of Wildlife internal report.

Mielke, J. 1950. Rate of deterioration of beetle-killed Engelmann spruce. Journal of Forestry, 48(12):882–888.

Millar, C.I., and N.L. Stephenson. 2015. Temperate forest health in an era of emerging megadisturbance. Science 349 (6250):823–826.

Mönkkönen, M., and P. Reunanen. 1999. On critical thresholds in landscape connectivity: A management perspective. Oikos 84(2):302–305.

Monroe, E.M., Alexander, K.D., and Britten, H.B. 2016. Still here after all these years: The persistence of the Uncompahgre fritillary butterfly. Journal of Insect Conservation 20(2):305–313. DOI: 10.1007/s10841-016-9867-9.

Mowat, G., Poole, K.G., and O’Donoghue, M., 2000. Ecology of lynx in northern Canada and Alaska. Pages 265–306 *in:* Ruggerio, L.F., Aubry, K.B., Buskirk, S.W., Koehler, G.M., Krebs, C.J., McKelvey, K.S., and Squires, J.R. (eds.), Ecology and Conservation of Lynx in the United States. University of Colorado Press, Boulder, Colorado.

National Wildlife Federation. 2005. No room at the top: High mountain species are particularly susceptible to global warming—and North America’s cold-loving pikas may be the most vulnerable of all. Online article accessed July 3, 2017, at: https://www.nwf.org/News-and-Magazines/National-Wildlife/Animals/Archives/2006/No-Room-at-the-Top.aspx

NatureServe Explorer. 2017. An online encyclopedia of life. Accessed September 2015 through May 18, 2017, at: http://explorer.natureserve.org/

Paxton, E.H., M.K. Sogge, T.C. Theimer, J. Girard, and P. Keim. 2008. Using molecular genetic markers to resolve a subspecies boundary: The northern boundary of the southwestern willow flycatcher in the Four-corner States. U.S. Geological Survey Open-File Report 2007–1117, 20 pp.

Paulson, D.D., and W.L. Baker. 2006. The nature of southwestern Colorado: Recognizing human legacies and restoring natural places. University Press of Colorado, Boulder, Colorado. 386 pp.

Pavlacky, D.C., and R.A. Sparks. 2016. Avian response to a large-scale spruce beetle outbreak on the Rio Grande National Forest, 2008–2014. Bird Conservancy of the Rockies, Ft. Collins Colorado. 93 pp.

Romme, W.H., M.L. Floyd, and D. Hanna. 2009. Historical range of variability and current landscape condition analysis: South central highlands section, southwestern Colorado and northwestern New Mexico. Report produced by the Colorado Forest Restoration Institute at Colorado State University and Region 2 of the U.S. Forest Service.

Ruediger, B., J. Claar, S. Gniadek, B. Holt, L. Lewis, S. Mighton, B. Naney, G. Patton, T. Rinaldi, J. Trick, A. Vandehey, F. Wahl, N. Warren, D. Wenger, and A. Williamson. 2000. Canada lynx conservation assessment and strategy (2nd ed.). USDA Forest Service, U.S. Fish and Wildlife Service, Bureau of Land Management, and National Park Service. Forest Service Publication R1-00-53, Missoula, Montana.

Ruggiero, L.F., K.B. Aubry, S.W. Buskirk, G.M. Koehler, C.J. Krebs, K.S. McKelvey, and J.R. Squires, (eds.) 2000. Ecology and conservation of lynx in the United States. University Press of Colorado. Boulder, Colorado. 480 pp.

Safford, H.D., M.P. North, and M.D. Meyer. 2012. Climate change and the relevance of historical forest conditions. Pages 23–46 *in:* North, M.P. (ed.). Managing Sierra Nevada Forests. General Technical Report PSW-GTR-237. USDA Forest Service Pacific Southwest Research Station, Albany, California.

Sclater, W.L. 1912. A history of the birds of Colorado. Witherby & Co. and Stechert & Co.

Smith, B.E., and D.A. Keinath. 2007. Northern leopard frog (*Rana pipiens*): A technical conservation assessment. USDA Forest Service, Rocky Mountain Region. Accessed June 29, 2015, at: http://www.fs.fed.us/r2/projects/scp/assessments/northernleopardfrog.pdf

Shenk, T.M. 2005. Canada lynx use of the Wolf Creek Pass area. Colorado Division of Wildlife report, Fort Collins, Colorado.

Shenk, T.M. 2006. Wildlife research monitoring report: Post-release monitoring of lynx reintroduced to Colorado. Colorado Division of Wildlife, Ft. Collins, Colorado. 45 pp.

Shenk, T.M. 2009. Lynx update, May 25, 2009. Colorado Division of Wildlife, Fort Collins, Colorado.

Somers, P., and L. Floyd-Hanna. 1996. Chapter 13: Wetlands, riparian habitats, and rivers. *In:* The Western San Juan Mountains: Their Geology, Ecology, and Human History. R. Blair, (ed.). University Press of Colorado. Boulder, Colorado. Pages 175–190 of 406.

Taylor, P.D., Fahrig, L., Henein, K., and Merriam, G. 1993. Connectivity is a vital element of landscape structure. Oikos 68:571–573.

Theobald, D.M., and T.M. Shenk. 2011. Areas of high habitat use from 1999-2010 for radio-collared Canada lynx reintroduced to Colorado. Accessed September 12, 2012, at: http://wildlife.state.co.us/Research/Mammal/Lynx/Pages/Lynx.aspx.

Tischendorf, L., and L. Fahrig. 2000. On the usage and measurement of landscape connectivity. Oikos 90:7–19.

USDA Forest Service. 2006. Decision Notice, Finding of No Significant Impact and Environmental Assessment: South San Juan Sheep and Goat Allotments. Conejos Peak Ranger District, Rio Grande National Forest. 228 pp.

USDA Forest Service. 2007. Recreation facility analysis 5-year proposed program of work and programmatic results of implementation - Rio Grande National Forest.

USDA Forest Service. 2008. Final Environmental Impact Statement, Southern Rockies Lynx Management Direction. Accessed May 19, 2017 at: https://www.fs.usda.gov/detail/r2/landmanagement/planning/?cid=stelprdb5356865

USDA Forest Service. 2010a, Final Environmental Impact Statement: North San Juan Sheep and Goat Allotments. Conejos Peak Range District, Rio Grande National Forest. 242 pp.

USDA Forest Service. 2010b. Region 2 species conservation assessments. Accessed July 6, 2017, at: https://www.fs.usda.gov/detail/r2/landmanagement/?cid=stelprdb5177128

USDA Forest Service. 2013. Environmental Assessment: Fisher-Ivy/Goose Lake Sheep Allotment. Divide Ranger District, Rio Grande National Forest. 259 pp. + appendices.

USDA Forest Service. 2014. Lynx and snowshoe hare response to spruce-beetle tree mortality, wildfire and timber salvage in spruce-fir forests of southern Colorado: Maintaining suitable habitat with a landscape restoration focus. Draft study proposal, prepared by Rio Grande National Forest staff J. Squires, J. Ivan, and R. Ghormley.

USDA Forest Service. 2015. RGNF species occurrence spreadsheet vers080715. Internal unpublished spreadsheet. Available from the Rio Grande National Forest, Monte Vista, Colorado.

USDA Forest Service. 2016. Rio Grande National Forest assessment reports. Prepared by Rio Grande National Forest staff, Monte Vista, Colorado. Accessed May 16, 2017, at: https://www.fs.usda.gov/detailfull/riogrande/landmanagement/projects/?cid=fseprd479245&width=full

USDA Forest Service. 2017a. Rio Grande National Forest: Fish and wildlife overview. Accessed May 19, 2017 at: https://www.fs.usda.gov/detail/riogrande/landmanagement/projects/?cid=fseprd534370

USDA Forest Service. 2017b. Rio Grande National Forest: SCC plants overview. Accessed May 19, 2017 at: https://www.fs.usda.gov/detail/riogrande/landmanagement/projects/?cid=fseprd534066

USDA Forest Service. 2017c. Aerial survey highlights for Colorado 2016.

USDA Forest Service. 2017d. Canada lynx habitat baseline update. Internal document prepared by Rio Grande National Forest staff, June 2017. 1 page.

USDA Forest Service Gunnison Service Center (GSC). 2016. 2016 Forest insect and disease conditions, Rio Grande National Forest. Internal report available at Rio Grande National Forest, Monte Vista, Colorado. 6 pp.

U.S. Fish and Wildlife Service. 1994. Uncompahgre fritillary butterfly recovery plan. Denver Colorado. 20 pp.

U.S. Fish and Wildlife Service. 2002. Southwestern willow flycatcher recovery plan. 210pp. plus appendices.

U.S. Fish and Wildlife Service. 2009. Uncompahgre fritillary butterfly (*Boloria acrocnema*), 5-year review: summary and evaluation. 19 pp.

U.S. Fish and Wildlife Service. 2012. Final recovery plan for the Mexican spotted owl (*Strix occidentalis lucida*), First revision. U.S. Fish and Wildlife Service. Albuquerque, New Mexico, USA. 413 pp.

U.S. Fish and Wildlife Service. 2013a. Canada lynx (*Lynx canadensis*) fact sheet. Accessed July 31, 2017, at: http://www.fws.gov/mountain-prairie/es/species/mammals/lynx/CandaLynxFactSheet_091613.pdf

U.S. Fish and Wildlife Service. 2013b. Mexican spotted owl; general biology and ecological relationships. Accessed on June 29, 2015 at: http://www.fws.gov/southwest/es/MSO_Main.html

U.S. Fish and Wildlife Service. 2014. Gunnison sage-grouse: Threatened designation and responsibilities under the Endangered Species Act. Mountain-Prairie Region.

U.S. Fish and Wildlife Service. 2015. Uncompahgre fritillary butterfly (*Boloria acrocnema*). Accessed on July 20, 2015 at: http://www.fws.gov/mountain-prairie/es/esUpdate/uncompahgreFritillaryButterfly.php

Veblen, T.T., K.S. Hadley, M.S. Reid, and A.J. Rebertus. 1991a. The response of subalpine forests to spruce beetle outbreak in Colorado. Ecology 72(1):213–231.

Veblen, T.T., K.S. Hadley, and M.S. Reid. 1991b. Disturbance and stand development of a Colorado subalpine forest. Journal of Biogeography 18:707–716.

Vose, J.M., D.L. Peterson, and T. Patel-Weynand (eds.). 2012. Effects of climatic variability and change on forest ecosystems: A comprehensive science synthesis for the U.S. forest sector. General Technical Report PNW-GTR-870, 265 pp. Prepared by USDA Forest Service, Pacific Northwest Research Station, Portland, Oregon. Accessed May 17, 2017, at: https://www.fs.fed.us/pnw/pubs/pnw_gtr870/pnw_gtr870.pdf

Wiens, J.A., G.D. Hayward, H.D. Safford, and C.M. Giffen (eds.). 2012. Historical environmental variation in conservation and natural resource management. Oxford, United Kingdom: Wiley-Blackwell. Pp. 46–52.

Wiggins, D. 2005. Yellow-billed cuckoo (*Coccyzus americanus*): A technical conservation assessment. USDA Forest Service, Rocky Mountain Region. Accessed on May 20, 2017, at: http://www.fs.fed.us/r2/projects/scp/assessments/yellowbilledcuckoo.pdf

Xerces Society for Invertebrate Conservation. 2017. Protecting the life that sustains us. Website accessed May 19, 2017, at: http://xerces.org/

Infrastructure, Roads, and Facilities

USDA Forest Service. 2016. Rio Grande National Forest assessment reports. Prepared by Rio Grande National Forest staff, Monte Vista, Colorado. Accessed May 16, 2017, at: https://www.fs.usda.gov/detailfull/riogrande/landmanagement/projects/?cid=fseprd479245&width=full

Scenery

USDA Forest Service. 1995. Landscape aesthetics: A handbook for scenery management. Forest Service Agriculture Handbook Number 701. Accessed April 24, 2017, at: https://www.fs.fed.us/cdt/carrying_capacity/landscape_aesthetics_handbook_701_no_append.pdf

USDA Forest Service. 2016. Rio Grande National Forest assessment reports. Prepared by Rio Grande National Forest staff, Monte Vista, Colorado. Accessed May 16, 2017, at: https://www.fs.usda.gov/detailfull/riogrande/landmanagement/projects/?cid=fseprd479245&width=full

Sustainable Recreation Opportunities, Access, Use, and Settings

San Luis Valley Great Outdoor Coalition. 2014. San Luis Valley trails and recreation plan. Accessed April 25, 2017, at: http://slvgo.com/wp-content/uploads/2015/08/SLVGO_FinalPlan-No-Chapter-5.pdf

USDA Forest Service. 1982. Recreation opportunity spectrum users guide. Accessed May 16, 2017, at: https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5277167.pdf

USDA Forest Service. 1990. ROS primer and field guide. Accessed April 25, 2017, at: https://www.fs.fed.us/cdt/carrying_capacity/rosfieldguide/ros_primer_and_field_guide.htm

USDA Forest Service. 2004. Roads analysis process report: Rio Grande National Forest. Prepared by Rio Grande National Forest staff, Monte Vista, Colorado. Accessed May 16, 2017, at: https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5167123.pdf

USDA Forest Service. 2007. Recreation facility analysis 5-year proposed program of work and programmatic results of implementation - Rio Grande National Forest.

USDA Forest Service. 2010. Connecting people with America's great outdoors: A framework for sustainable recreation. Forest Service Recreation, Heritage and Volunteer Resources, 8 pp. Accessed April 25, 2017, at https://www.nationalforests.org/assets/pdfs/Framework-for-Sustainable-Recreation.pdf

USDA Forest Service. 2015a. Leadership intent for outdoor recreation: Rocky Mountain Region. Accessed April 25, 2017, at: https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd479065.pdf

USDA Forest Service. 2015b. Rio Grande National Forest: Forest-wide travel analysis process report. Prepared by Rio Grande National Forest staff, Monte Vista, Colorado. Accessed April 25, 2017, at: https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd484845.pdf

USDA Forest Service. 2015c. National visitor use monitoring survey for the Rio Grande National Forest. Accessed April 25, 2017, at: http://apps.fs.fed.us/nfs/nrm/nvum/results/A02009.aspx/FY2015

USDA Forest Service. 2016a. Draft national recreation opportunity spectrum mapping protocol.

USDA Forest Service. 2016b. Rio Grande National Forest assessment reports. Prepared by Rio Grande National Forest staff, Monte Vista, Colorado. Accessed May 16, 2017, at: https://www.fs.usda.gov/detailfull/riogrande/landmanagement/projects/?cid=fseprd479245&width=full

USDA Forest Service. 2017. Rio Grande National Forest: Travel management. Website accessed April 26, 2017.

Congressionally Designated Trails

USDA Forest Service. 2009. The 2009 Continental Divide National Scenic Trail Comprehensive Plan. Accessed April 25, 2017, at: https://www.fs.fed.us/cdt/main/cdnst_comprehensive_plan_final_092809.pdf

Cultural Resources

USDA Forest Service. 2016. Rio Grande National Forest assessment reports. Prepared by Rio Grande National Forest staff, Monte Vista, Colorado. Accessed May 16, 2017, at: https://www.fs.usda.gov/detailfull/riogrande/landmanagement/projects/?cid=fseprd479245&width=full

Recommended Wilderness

Cordell, H.K., Betz, C.J., Bowker, J.M., English, D.B.K., Mou, S.H., Bergstrom, J.C., Teasley, R.J., Tarrant, M.A., and Loomis, J. 1999. Outdoor recreation in American life: a national assessment of demand and supply trends. Champaign, Illinois: Sagamore Publishing, xii, 449 pp.

Rosenberger, R.S., and J.B. Loomis. 2001. Benefit transfer of outdoor recreation use values: A technical document supporting the Forest Service Strategic Plan (2000 revision). General Technical Report RMRS-GTR-72. Fort Collins, Colorado: USDA Forest Service, Rocky Mountain Research Station. 59 pp.

USDA Forest Service. 2016c. Rio Grande National Forest – Draft wilderness evaluations. Prepared by Rio Grande National Forest staff, Monte Vista, Colorado. 78 pp plus map. Accessed August 2, 2017, at: https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd521710.pdf

Proposed Special Interest Areas and Research Natural Areas

USDA Forest Service. 2016. Rio Grande National Forest assessment reports. Prepared by Rio Grande National Forest staff, Monte Vista, Colorado. Accessed May 16, 2017, at: https://www.fs.usda.gov/detailfull/riogrande/landmanagement/projects/?cid=fseprd479245&width=full

Areas of Tribal Importance

USDA Forest Service. 2016. Rio Grande National Forest assessment reports. Prepared by Rio Grande National Forest staff, Monte Vista, Colorado. Accessed May 16, 2017, at: https://www.fs.usda.gov/detailfull/riogrande/landmanagement/projects/?cid=fseprd479245&width=full

Contributions to Social and Economic Sustainability

Attaran, M. 1986. Industrial diversity and economic performance in U.S. areas. Annals of Regional Science 20(2):44–55.

Boyd, J.W., and S. Banzhaf. 2007. What are ecosystem services? The need for standardized environmental accounting units. Ecological Economics 63:616–26.

Brown, T.C., P.M. Froemke, V. Mahat, and J. Ramirez. 2016. Mean annual renewable water supply of the contiguous United States. Briefing paper. USDA Forest Service Rocky Mountain Research Station, Fort Collins, Colorado. 55 pp.

Brown, G., and Reed, P. 2000. Validation of a forest values typology for use in national forest planning. Forest Science 46(2):240–247.

Clark, D., and W. Hunter. 1992. The impact of economic opportunity, amenities and fiscal factors on age-specific migration rates. Journal of Regional Science 32(3):349–365.

Climate and Traditional Knowledges Workgroup. 2014. Section 1: Climate change and indigenous peoples: A primer. Section 2: Traditional knowledges guidelines. Retrieved from https://climatetkw.wordpress.com/guidelines/

Colby, S.L., and J.M. Ortman. 2014. Projections of the size and composition of the U.S. population: 2014 to 2060. Washington DC. U.S. Census Bureau, Current Population Reports, pp. 25–1143.

Colorado Department of Local Affairs. 2011. Division of Local Governments, State Demography Office. Program description of location economic information and forecasting assistance. Updated August 2011. Accessed July 17, 2017, at: https://demography.dola.colorado.gov/economy-labor-force/

Colorado Department of Local Affairs. 2017a. Understanding Colorado regions. Website accessed July 14, 2017, at: https://demography.dola.colorado.gov/gis/colorado-regions/

Colorado Department of Local Affairs. 2017b. Division of Local Governments, State Demography Office. Economy and Labor Force: Data and Lookups. Retrieved February 2017 from: https://demography.dola.colorado.gov/economy-labor-force/data/

Colorado Department of Local Affairs. 2017c. Division of Local Governments, State Demography Office. Economy and labor force: Data and lookups. Accessed February 2017 at: https://demography.dola.colorado.gov/economy-labor-force/data/

Daly, H.E., 1997. Beyond growth: The economics of sustainable development. Beacon Press, Boston.

English, D.B.K., Froemke, P., and Hawkos, K. 2015. Paths more traveled: Predicting future recreation pressures on America's national forests and grasslands. A Forests on the Edge Report. FS-1034. Washington, DC: USDA Forest Service. 36 pp. Accessed July 27, 2017, at: https://www.fs.fed.us/openspace/fote/reports/508_Paths%20More%20Traveled_Final.pdf

Forest Stewardship Concepts, Ltd. 2014. Rio Grande Basin watershed health and forest biomass opportunities evaluation. Report prepared for the Rio Grande Watershed Emergency Action Coordination Team. 28 pp.

Gentner, B., and J.A. Tanaka. 2002. Classifying Federal public land grazing permittees. Journal of Range Management 55(1):2–11.

Goerner, S.J., B. Lietaer, and R.E. Ulanowicz. 2009. Quantifying economic sustainability: Implications for free-enterprise theory, policy and practice. Ecological Economics 69(1):76–81.

Headwater Economics. 2015. Three Wests: The impact of access to markets on economic performance in the West: Methods, definitions, and data sources, October 2015.

Hecla Mining Company. 2017. San Juan Silver: Creede, CO. Website accessed May 15, 2017, at: http://www.hecla-mining.com/san-juan/

IMPLAN. 2014. Minnesota IMPLAN Group. Data for purchase and additional information is available at: http://www.implan.com/

Indiana Business Research Center. 2016. Driving regional innovation: The Innovation Index 2.0. Accessed June 15, 2017, at: https://www.statsamerica.org/ii2/reports/Driving-Regional-Innovation.pdf

Keegan, C.E., Morgan, T.A., Wagner, F.G., Cohn, P.J., Blatner, K.A., Spoelma, T.P., and Shook, S.R. 2005. Capacity for utilization of USDA Forest Service, Region 1 small-diameter timber. Forest Products Journal 55(12):143–147.

Keegan, C.E., Morgan, T.A., Gebert, K.M. Brandt, J.P., Blatner, K.A., and Spoelma, T.P. 2006. Timber-processing capacity and capabilities in the Western United States. Journal of Forestry 104(5): 262–268.

Keegan, C., C.B. Sorenson, T.A. Morgan, S.W. Hayes, and J.M. Daniels. 2011. Impact of the Great Recession and housing collapse on the forest products industry in the Western United States. Forest Products Journal 61(8):625–634.

Knapp, T.A., and P.E. Graves. 1989. On the role of amenities in models of migration and regional development. Journal of Regional Science 29(1):71–87.

Lewis, D., G.L. Hunt, and A.J. Plantinga. 2002. Public conservation land and employment growth in the northern forest region. Land Economics 78(2):245–259.

Livneh, B., E.A. Rosenberg, C. Lin, B. Nijssen, V. Mishra, K.M. Andreadis, E.P. Maurer, and D.P. Lettenmaier. 2013. A long-term hydrologically based dataset of land surface fluxes and states for the conterminous United States: Update and extensions. Journal of Climate 26.

Luce, C.H. 2016. National forest contributions to streamflow. Rocky Mountain Research Station, Boise, ID.

Marcouiller, D.W., and X. Xia. 2008. Distribution of income from tourism sensitive employment. Tourism Economics 14(3)545–565.

Maupin, M.A., Kenny, J.F., Hutson, S.S., Lovelace, J.K., Barber, N.L., and Linsey, K.S. 2014. Estimated use of water in the United States in 2010: U.S. Geological Survey Circular 1405, 56 pp. Available at: https://pubs.usgs.gov/circ/1405/

McGranahan, D.A. 1999. Natural amenities drive rural population change. Agricultural Economic Report no. 781. Washington, DC: Food and Rural Economics Division, Economic Research Service, U.S. Department of Agriculture. Section 6.2.

McIver, C.P., E.A. Simmons, and T. A. Morgan. 2017. Timber use, processing capacity and capability of mills to utilize timber by diameter size class in the Rio Grande National Forest Timber-Processing Area. Submitted to: Kawa Ng, USDA Forest Service, Rocky Mountain Region. Agreement No. AG-16-CS-11020000-075. Forest Industry Research Program, Bureau of Business and Economic Research, University of Montana.

McKenna, M.F., Lignell, B., Rapoza, A., Lee, C., Ward, V., and Rocchio, J. 2015. A framework to assess the effects of commercial air tour noise on wilderness. Journal of Forestry, Society of American Foresters 113(8). Available at: http://dx.doi.org/10.5849/jof.14-135

Mueser, P.R., and P.E. Graves. 1995. Examining the role of economic opportunity and amenities in explaining population redistribution. Journal of Urban Economics 37(2):176–200.

Ng, K. 2014. Economic sustainability: A discussion on indicators and measures. Western Forest Economists 2014 meeting, Missoula, Montana. Accessed June 15, 2017, at: http://www.westernforesteconomists.org/?page_id=51

Ng, K. 2015. Economic sustainability in forest planning under the 2012 U.S. Forest Service Planning Rule. Ecosystem Management Coordination Staff, Washington Office – Fort Collins Detached Unit, USDA Forest Service. Fort Collins, Colorado.

Ng, K., and C. Miller. 2014. Considering ecosystem services and economic sustainability in forest planning: Feasible options. A Community on Ecosystem Services (ACES) 2014, Washington, D.C.

Rimbley, T., and Torrell, L.A. 2011. Grazing costs: What's the current situation? Moscow, Idaho: University of Idaho.

Saisana, M., and D. Philippas. 2012. Sustainable Society Index (SSI): Taking societies' pulse along social, environmental and economic issues. The Joint Research Centre audit on the SSI. EU.

Scott, D. 2003. A mandate to protect America's wilderness. Campaign for America's Wilderness. Washington, D.C.

Shannon, C.E. and W. Weaver. 1949. The mathematical theory of communication. The University of Illinois Press, Urbana, Illinois.

Treyz, G.I., D.S. Rickman, G.L. Hunt, and M.J. Greenwood. 1993. The dynamics of U.S. internal migration. The Review of Economics and Statistics 75(2):209–14.

U.S. Bureau of Labor and Statistics. 2016. Local area unemployment statistics. https://www.bls.gov

U.S. Bureau of Labor Statistics. 2017a. Quarterly census of employment and wages, 2015. Accessed June 15, 2017, at: https://www.bls.gov

U.S. Bureau of Labor Statistics. 2017b. Productivity and costs, fourth quarter and annual averages 2016, revised. https://www.bls.gov/news.release/prod2.nr0.htm

U.S. Census Bureau. 1970. Population and housing unit estimates – County intercensal datasets. Accessed July 28, 2017, at: https://www.census.gov/programs-surveys/popest/data/data-sets.1970.html

U.S. Census Bureau. 2013. 2013 population estimates. Accessed July 28, 2017, at: https://factfinder.census.gov

U.S. Census Bureau. 2016. American community survey five year estimates, 2011–2015. Washington, D.C. As reported in Headwaters Economics' Economic Profile System. Accessed June 15, 2017, at: www.headwaterseconomics.org/eps

USDA Economic Research Service. 2016. County typology codes. Accessed June 15, 2017, at: http://www.ers.usda.gov/data-products/county-typology-codes/documentation.aspx

USDA Economic Research Service. 2017. Creative Class County Codes – Documentation. Accessed June 15, 2017, at: https://www.ers.usda.gov/data-products/creative-class-county-codes/documentation/

USDA Forest Service. 2003. Understanding community-forest relations. General Technical Report PNW-GTR-566. Kruger, L.E. (tech. ed.), Pacific Northwest Research Station, Portland, Oregon. Accessed July 28, 2017, at: https://www.fs.fed.us/pnw/pubs/pnw_gtr566.pdf

USDA Forest Service. 2012–2016. Forest products cut and sold from the national forests and grasslands. Accessed June 15, 2017, at: https://www.fs.fed.us/forestmanagement/products/cut-sold/index.shtml

USDA Forest Service. 2013a. Secure rural schools. Election and allocation guidelines. Accessed June 15, 2017, at: https://www.fs.usda.gov/main/pts/securepayments/election-allocationguidelines

USDA Forest Service. 2013b. FAQs for Title 1 – Secure payments for states and counties. Accessed June 15, 2017, at: https://www.fs.usda.gov/main/pts/securepayments/faqs

USDA Forest Service. 2016. Rio Grande National Forest assessment reports. Prepared by Rio Grande National Forest staff, Monte Vista, Colorado. Accessed May 16, 2017, at: https://www.fs.usda.gov/detailfull/riogrande/landmanagement/projects/?cid=fseprd479245&width=full

U.S. Department of Agriculture. 2012. National Agricultural Statistics Service, Census of Agriculture. Accessed July 28, 2017, at: http://www.agcensus.usda.gov

U.S. Department of Commerce. 2014. Bureau of Economic Analysis, Regional Economic Accounts, Washington, Table CA05 and CA05N. Accessed from Page 5 of Measures Report from Economic Profile System – Human Dimensions Toolkit, June 18, 2015.

U.S. Department of Commerce and the President's Committee on the Arts and the Humanities for the 2005 U.S. Cultural and Heritage Tourism Summit. 2005. A position paper on cultural and heritage tourism in the United States. Accessed June 15, 2017, at: https://www.pcah.gov/sites/default/files/05WhitePaperCultHeritTourism_2.pdf

U.S Department of Interior. 2016. Payment in lieu of taxes – County payments. Accessed June 15, 2017, at: https://www.nbc.gov/pilt/counties.cfm

Vaughan, D., and K. Mackes. 2014. Characteristics of Colorado forestry contractors and their role in current forest health issues. Forest Products Journal 65(5/6).

Watson, A., Martin, S., Christensen, N., Fauth, G., and Williams, D. 2015. The relationship between perceptions of wilderness character and attitudes toward management intervention to adapt biophysical resources to a changing climate and nature restoration at Sequoia and Kings Canyon National Parks. Environmental Management 56(3):653–663. doi:10.1007/s00267-015-0519-8.

Wildrose Appraisal Inc. 2014a. 2014 Conejos County property assessment study. Wildrose Appraisal Inc. – Audit Division. Available in the project record.

Wildrose Appraisal Inc. 2014b. 2014 Saguache County property assessment study. Wildrose Appraisal Inc. – Audit Division. Available in the project record.

Wildrose Appraisal Inc. 2015a. 2015 Alamosa County property assessment study. Wildrose Appraisal Inc. – Audit Division. Available in the project record.

Wildrose Appraisal Inc. 2015b. 2015 Rio Grande County property assessment study. Wildrose Appraisal Inc. – Audit Division. Available in the project record.

Glossary

A

Access

Road or trail route over which a public agency claims a right-of-way for public use; a way of approach.

Activity fuels

Fuels resulting from or altered by forestry practices such as timber harvest or thinning, as opposed to naturally created fuels.

Adaptive management

An approach to natural resource management where actions are designed and executed and effects are monitored for the purpose of learning and adjusting future management actions, which improves the efficiency and responsiveness of management.

Age class

Age class is one of the intervals, commonly 10 years, into which the age range of trees is divided for classification or use. Age class distribution refers to the location and/or proportionate representation of different age classes in a forest.

Air quality: Class I, II, and III areas

The area classification scheme established by Congress to facilitate implementation of the prevention of significant deterioration of the air quality provisions of the Clean Air Act.

Class I areas receive the highest degree of protection, with only a small amount of certain kinds of additional air pollution allowed.

Mandatory Class I areas were designated by Congress and include international parks, national wilderness areas or national memorial parks larger than 5,000 acres, or national parks larger than 6,000 acres, that were in existence (or authorized) on August 7, 1977. The 1990 amendments to the Clean Air Act specified that acreage added to these areas after 1977 must also receive Class I designation. Mandatory Class I areas may not be redesignated to any other classification.

Congress initially designated all other attainment areas as **Class II** and allowed a moderate increase in certain air pollutants.

No **Class III areas**, where a large amount of new air pollution would be allowed, were designated by Congress, but a process was established for redesignating Class II areas to the more protective Class I or the less protective Class III status. Only states or Native American governing bodies have authority to redesignate these areas, except as noted above.

Air quality related values

Resource that may be adversely affected by a change in air quality. The resource may include visibility or a specific scenic, cultural, physical, biological, ecological, or recreational resource. Values are specific for each designated wilderness area.

Airshed

A geographical area that, because of topography, meteorology, and/or climate is frequently affected by the same air mass.

Arborglyph

Arborglyphs, dendroglyphs, silvaglyphs, modified cultural trees, or aspen carvings are tree carvings made in the bark of aspen trees by shepherds, many of them Basque, Hispanic, Peruvian, and Irish American, throughout the Western United States.

Area of Influence

An area influenced by the management of the plan area that is used during the land management planning process to evaluate social, cultural, and economic conditions. The area is usually a grouping of counties.

Assessment

For the purposes of land management planning at 36 CFR 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 their borders.

At-risk species

A term used to collectively refer to the federally recognized threatened, endangered, proposed, and candidate species and species of conservation concern within the planning area.

Aquatic ecosystem

Waters of the United States that serve as habitat for interrelated and interacting communities and populations of plants and animals. It includes the stream channel, lake or estuary bed, water, biotic communities, and the habitat features that occur.

B

Background

A term used in scenery management to describe that part of a scene or landscape that is farthest from the viewer, typically 3 miles to infinity from the observer.

Bark beetles

Bark beetles are members of the family Scolytidae whose adults and larvae tunnel in the cambium region (bark and sapwood) of living, dying, and recently dead or felled trees.

Basal area

The cross-sectional area, in square feet, of a tree measured at breast height (4.5 feet). Basal area of an area is generally estimated in terms of square feet per acre.

Beneficial uses

Any of the various uses that may be made of the water, including, but not limited to, domestic water supplies, fisheries and other aquatic life, industrial water supplies, agricultural water supplies, navigation, recreation in and on the water, wildlife habitat, and aesthetics.

Best management practices

Methods or techniques that have been determined to be the most effective and practical means of achieving an objective while making the optimum use of resources.

Big game

Those species of large mammals normally managed for sport hunting, generally including antelope, bighorn sheep, deer, elk, moose, and mountain goat.

Big game (crucial) winter range

Big game winter range is where a population or portion of a population of animals uses the documented suitable habitat within this range annually, in substantial numbers only during the winter. Crucial winter range describes any portion of the range which has been documented as the determining factor in a population's ability to maintain itself at a certain level over the long term.

Biological diversity, or biodiversity

The full variety of life in an area, including the ecosystem, plant, and animal communities, species and genes, and the processes through which individual organisms interact with one another and with their environment.

Biological evaluation

As defined by FSM 2670.5, a biological evaluation is a documented Forest Service review of Forest Service programs or activities in sufficient detail to determine how an action or proposed action may affect any threatened, endangered, proposed, or sensitive species. FSM 2672.4 identifies biological evaluation objectives and standards.

Biological opinion

Biological opinions document a U.S. Fish and Wildlife Service opinion as to whether a Federal action is likely to jeopardize the continued of an Endangered Species Act-listed species, or result in the destruction or adverse modification of species' critical habitat.

Biotic

Typically refers to living organisms in their ecological rather than their physiological relations.

Board foot (BF)

Measure of an amount of timber equivalent to a piece of 12-inch x 12-inch x 1-inch lumber.

Broadcast burning

Allowing a prescribed fire to burn over a designated area within well-defined boundaries to achieve some land management objective.

Browse

The buds, shoots, and leaves of woody plants eaten by livestock or wild animals.

C

Canada lynx

The Canada lynx (*Lynx canadensis*) is a North American mammal of the cat family, Felidae, which ranges across Canada and into Alaska as well as some parts of the northern United States, including Colorado.

Candidate species

For species under the purview of the U.S. Fish and Wildlife Service (Service), a species for which the Service possesses sufficient information on vulnerability and threat to support a proposal to list as endangered or threatened, but for which no proposed rule has yet been published.

Canopy

The uppermost spreading, branchy layer of a forest.

Canopy cover

The proportion or percentage of the forest floor covered by the vertical projection of tree crowns.

Capability

The potential of an area to produce resources, supply goods and services, and allow resource uses under an assumed set of management practices and at a given level of management intensity. Capability depends on current management practices at a given level of management intensity. It is also dependent on existing resource and site conditions such as climate, slope, landform, soil, and geology, as well as the application of management practices, such as silviculture or the protection from fire, insects, and disease.

Carr

A type of waterlogged wooded terrain that typically represents a successional stage between swamp and the eventual formation of forest. Characteristic trees include alder and willow.

Cavity-nesting species

Wildlife species that excavate and/or occupy cavities in trees and snags.

Channel

A passage, either naturally or artificially created, that periodically or continuously contains moving water, or that forms a connecting link between two bodies of water. River, creek, run, branch, and tributary are some of the terms used to describe natural channels, which may be single or braided. Canal and floodway are some of the terms used to describe artificial channels.

Clearcut

1. A stand in which essentially all trees have been removed in one operation to produce an even-aged stand. Depending on management objectives, a clearcut may or may not have reserve trees left to attain goals other than regeneration (see regeneration method two-aged methods).

2. A regeneration or harvest method that removes essentially all trees in a stand. A minor live component of the stand may be retained for purposes other than regeneration. The retained trees, referred to as leave trees, should generally comprise less than 10 percent of the growing space of the stand.

Climax

The culminating stage in plant succession for a given site where the vegetation has reached a highly stable condition.

Clone

A group of plants (for example, aspen) growing in close association, derived by asexual reproduction from a single parent plant.

Coarse woody debris

Provides living spaces for a host of organisms and serves as long-term storage sites for moisture, nutrients, and energy. Coarse woody debris consists of any woody material greater than 3 inches in diameter and is derived from tree limbs, boles, roots, and large wood fragments and fallen trees in various stages of decay.

Code of Federal Regulations (CFR)

The listing of various regulations pertaining to management and administration of national forests and other Federal lands.

Collaboration

Working with someone to produce or create something.

Commercial thinning

An intermediate harvest of commercial-sized trees to meet a variety of management objectives including reducing stand density to improve tree growth, improving forest health, or to meet other stand structural or composition objectives.

Common variety minerals

Deposits that do not possess a distinctly special economic value, although they may have value for use in trade or manufacture. These minerals include sand, stone, gravel, pumicite, cinders, and pumice.

Confluence

The point where two streams meet.

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 fluctuations in climate.

Conservation status rank

Conservation status ranks estimate a species risk of elimination. Status ranks are based on a 1 to 5 scale, 1 denoting a species is critically imperiled and 5 denoting a species is secure. Species status is assessed at three geographic scales: global (G), national (N), and state/province (S). The overall status of a species is denoted by its G-rank, while its condition in a particular country is denotes by its N-rank, and its condition in a particular state/province is denoted by its S-rank. Subspecies, varieties, or any other designation below the level of a global ranked species, receive a T-rank that denotes their conservation status. A species may receive a B- or N-rank that refers to the conservation status of the breeding (B) or nonbreeding (N) population in a particular nation or state/province. (NatureServe 2017)

Conservation strategy

A conservation strategy is a management scheme or plan to conserve or sustain particular ecosystem elements such as rare species or habitats. An example of a conservation strategy is to survey for potential habitats during project planning in order to protect known populations of a rare species through project-specific measures.

Constraint

A qualification of the minimum or maximum amount of an output or cost that could be produced or incurred in a given time period.

Construction

The displacement of vegetation, soil, rock, and the installation of human-made structures involved in the process of building a complete, permanent road facility. The activities occur at a location or corridor that is not currently occupied by a road.

Consumptive use

A use of resources that reduces the supply, such as mining, hunting, and fishing.

Contain

To surround a fire and any spot fires with a control line as needed, which can reasonably be expected to check the fire's spread under prevailing conditions.

Coppice (Coppice with standards)

Coppice is a vegetation reproduction method with clear felling or clearcutting. Clear felling stimulates sprouting from the residual roots. Standards are selected overstory trees reserved for a longer rotation at the time each crop of coppice material is cut.

Corridor (utility or right-of-way)

A linear strip of land defined for the present or future location of transportation or utility right-of-way within its boundaries.

Council on Environmental Quality

An advisory council to the President established by the National Environmental Policy Act of 1969. It reviews Federal programs for their effects on the environment, conducts environmental studies, and advises the President on environmental matters.

Cover type

The dominant vegetation in an area—for example, aspen, ponderosa pine, or sedges.

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 under the Endangered Species Act, on which are found those physical or biological features (a) essential to the conservation of the species, and (b) which may require species management considerations or protection; and (2) specific areas outside of the geographical area occupied by the species at the time it is listed, upon a determination by the Secretary that such area are essential for the conservation of the species. Critical habitat is designated through rule making by the Secretary of the Interior or Commerce.

Critical load

The concentration of air pollution or total deposition of pollutants above which specific deleterious effects may occur.

Crown

The upper part of a tree or other woody plant carrying the main branch system and foliage.

Culmination of mean annual increment

Mean annual increment of growth and culmination of mean annual increment of growth. Mean annual increment of growth is the total increment of increase of volume of a stand (standing crop plus thinnings) up to a given age divided by that age. Culmination of mean annual increment of growth is the age in the growth cycle of an even-aged stand at which the average annual rate of increase of volume is at a maximum. In land management plans, mean annual increment is expressed in cubic measure and is based on the expected growth of stands, according to intensities and utilization guidelines in the plan.

Cultural landscapes

Cultural resources that represent the combined works of nature and humans.

Cultural resource inventory

The record of cultural resources known to occur within a defined geographic area. An inventory includes a compilation and synthesis of existing information and field surveys for evidence of past human activity. In areas where the ground surface is difficult to see, field survey may include subsurface probing to determine the presence or absence of cultural material.

Cultural resources

An object or definite location of human activity, occupation, or use identifiable through field survey, historical documentation, or oral evidence. Cultural resources are prehistoric, historic, archaeological, or architectural sites, structures, places, or objects and traditional cultural properties. Cultural resources include the entire spectrum of resources for which the Heritage Program is responsible, from artifacts to cultural landscapes, without regard to eligibility for listing on the National Register of Historic Places.

Cumulative effects

Results of collective past, present, and reasonably foreseeable future actions.

Cumulative impacts

Impacts on the environment that result from the incremental impact of an action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

D

Decadence

A process, condition, or period of deterioration or decline.

Deciduous

A deciduous tree or shrub sheds its leaves annually.

Decommission

Demolition, dismantling, removal, obliteration, and/or disposal of a deteriorated or otherwise unneeded asset or component, including necessary cleanup work. This action eliminates the deferred maintenance needs for the fixed asset. Decommissioning roads includes activities that result in the stabilization and restoration of unneeded roads to a more natural state.

Deferred maintenance

Maintenance that was not performed when it should have been or when it was scheduled and which was delayed. When allowed to accumulate without limits or consideration of useful life, deferred maintenance leads to deterioration of performance, increases costs to repair, and decrease in net value.

Degradation

To wear down by erosion, especially through stream action.

Demand

The amount of an output that users are willing to take at a specified price, time period, and condition of sale.

Designated wilderness

Designated wilderness refers to any area of land designated by Congress as part of the National Wilderness Preservation System that was established by the Wilderness Act of 1964.

Desired condition

A description of specific social, economic, and/or ecological characteristics of the plan area, or a portion of the plan area, toward which management of the land and resources should be directed. (36 CFR 219.7(e)(1)(i))

Developed recreation

Recreation that occurs at man-made developments such as campgrounds, picnic grounds, resorts, ski areas, trailheads, etc. Facilities might include roads, parking lots, picnic tables, toilets, drinking water, ski lifts, and buildings. Campgrounds and picnic areas are examples of developed recreation sites.

Developed site

Developed recreation sites are relatively small, distinctly defined areas where facilities are provided for concentrated public use, such as campgrounds and picnic areas.

Diameter at breast height (dbh)

The diameter of a standing tree measured at a point 4 feet 6 inches from ground level on the uphill side.

Direct effects

Results of an action occurring when and where that action takes place.

Dispersed recreation

Outdoor recreation that is spread out over the land and in conjunction with roads, trails, and undeveloped waterways. Activities are typically day-use oriented and include hunting, fishing, boating, hiking, off-road vehicle use, cross-country skiing, motorbiking, and mountain climbing.

Disturbance

Any relatively discrete event in time that disrupts ecosystem, watershed, community, or species population structure and/or function and changes resources, substrate availability, or the physical environment.

Diversity

The distribution and abundance of different plant and animal communities and species within an area. This term is not synonymous with "biological diversity."

Down or downed

A tree or portion of a tree that is dead and lying on the ground.

Down woody material or debris

Woody material, from any source, that is dead and lying on the forest floor.

E

Easement

A right afforded a person or agency to make limited use of another's real property for access or other purposes.

Ecological conditions

The 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 of ecological conditions include the abundance and distribution of aquatic and terrestrial habitats, connectivity, roads, and other structural developments, human uses, and invasive species.

Ecological integrity

The quality or condition of an ecosystem when its dominant ecological characteristics (for example, composition, structure, function, connectivity, and species composition and diversity) occur within the natural range of variation and can withstand and recover from most perturbations imposed by natural environmental dynamics or human influences.

Ecological process

The actions or events that link organisms (including humans) and their environment, such as disturbance, successional development, nutrient cycling, carbon sequestration, productivity, and decay.

Ecological sustainability

The capability of ecosystems to maintain ecological integrity.

Economic sustainability

The capability of society to produce and consume or otherwise benefit from goods and services, including contributions to jobs and market and nonmarket benefits.

Ecoregion

A continuous geographic area over which the macroclimate is sufficiently uniform to permit development of similar ecosystems on sites with similar properties. Ecoregions contain multiple landscapes with different spatial patterns of ecosystems.

Ecosystem

A spatially explicit, relatively homogenous unit of the Earth that includes all interacting organisms and elements of the abiotic environment within its boundaries. Usually described in terms of its composition, structure, function, and connectivity.

Ecosystem services

The direct and indirect contributions of ecosystems to human well-being. They directly or indirectly support survival and quality of life. Ecosystem services can be categorized into types:

Provisioning services – products obtained from ecosystems such as food, fresh water, wood, fiber, genetic resources, and medicines.

Regulating services – benefits obtained from the regulation of ecosystem processes such as climate and natural hazards, water purification, waste management, pollination, and pest control.

Cultural services – nonmaterial benefits that people obtain from ecosystems such as spiritual enrichment, intellectual development, recreation, and aesthetic values.

Supporting services – ecosystem services that are necessary for the production of all other ecosystem services. Examples include biomass production, production of atmospheric oxygen, soil formation and retention, nutrient cycling, water cycling, and provisioning of habitat.

Edaphic

Of, produced by, or influenced by the soil; related or caused by particular soil conditions, as of texture or drainage, rather than by physiographic or climatic factors.

Edge

The place where plant communities meet or where successional stages or vegetative conditions within plant communities come together.

Endangered species

Any species that the Secretary of Interior or the Secretary of Commerce has determined is in danger of extinction throughout all or a significant portion of its range.

Endangered Species Act

Public Law 93-205, approved in 1973 and since amended, the Endangered Species Act provides for the conservation of ecosystems upon which threatened and endangered species of fish, wildlife, and plants depend.

Environmental Impact Statement (EIS)

A formal public document prepared to analyze the impacts on the environment of a proposed project or action and released for comment and review. It is prepared first in draft or review form and later in final form. An EIS must meet the requirements of the National Environmental Policy Act (NEPA), the Council on Environmental Quality (CEQ) guidelines, and directives of the agency responsible for the proposed project. An impact statement includes the following points: 1) the environmental impact of the proposed action, 2) any adverse impacts that cannot be avoided by the action, 3) the alternative courses of actions, 4) the relationships between local short-term use of the human environment and the maintenance and enhancement of long-term productivity, and 5) a description of the irreversible and irretrievable commitment of resources, which would occur if the action were accomplished.

Environmental justice population

A group of people that meets the criterion for low income or minority under Executive Order 12898. An environmental justice population may be both low-income and minority.

Erosion

Detachment or movement of the land surface by water, wind, ice, gravity, or other geological activity. Accelerated erosion is much more rapid than normal, natural, geologic erosion, primarily as a result of the influence of activities of man, animals, or natural catastrophes.

Evapotranspiration

The sum total of water lost from the land by evaporation (water loss from soil or plant surfaces) and plant transpiration (water absorbed by plants from soil and translocated to the leaves).

Even-aged management

The application of a combination of actions that results in the creation of stands in which trees of essentially the same age grow together. Managed even-aged forests are characterized by a distribution of stands of varying ages (and therefore, tree sizes throughout the forested area). The difference in age between trees forming the main canopy level of a stand generally does not exceed 20 percent of the age of the stand at harvest rotation age. Regeneration in a particular stand is obtained during a short period at or near the time that a stand has reached the desired age or size for regeneration and is harvested. Clearcut, shelterwood, or seed-tree cutting methods produce even-aged stands (36 CFR 219.3).

Executive order

An order of regulation issued by the President or some administrative authority under his or her direction.

Exurban

A region or settlement that typically lies beyond the suburbs of a city and is chiefly inhabited by well-to-do families.

F

Facility

Structures needed to support the management, protection, and use of the national forests, including buildings, utility systems, dams, and other construction features. There are three types of facilities: recreation, administrative, and permittee.

Fen

An ancient wetland ecosystem dependent on nutrient-rich local or regional groundwater flow systems maintaining perennial soil saturation and supporting continuous organic soil (i.e., peat) accumulation. (FS-990A)

Fire management plan

A plan that identifies and integrates all wildland fire management and related activities within the context of approved land and resource management plans. It defines a program to manage wildland fires (wildfire and prescribed fire). The plan is supplemented by operational plans, including but not limited to preparedness plans, preplanned dispatch plans, prescribed fire burn plans, and prevention plans. Fire management plans assure that wildland fire management goals and components are coordinated.

Fire regime

Description of the patterns of fire occurrences, frequency, size, severity, and sometimes vegetation and fire effects as well, in a given area or ecosystem. A fire regime is a generalization based on fire histories at individual sites. Fire regimes typically are described as cycles because some parts of the histories are repeated, and the repetitions can be counted and measured, such as fire return interval.

Fire regime condition class

Fire regime condition class is an expression of the departure of the current condition from the historical fire regime. It is derived from the historical fire regime and the current fire severity. It is used as a proxy for the probability of severe fire effects, e.g., the loss of key ecosystem components—soil, vegetation, structure—or alteration of key ecosystem processes—nutrient cycles, hydrologic regimes. The fire regime condition class is an index of ecosystem risks attributable to wildland fire.

Fire suppression

All the work and activities connected with fire-extinguishing operations, beginning with discovery and continuing until the fire is completely extinguished. The four fire suppression strategies are:

Monitor – the systematic process of observing, collecting, and recording fire-related data, particularly with regard to fuels, topography, weather, fire behavior, fire effects, smoke, and fire location. This may be done onsite, from a nearby or distant vantage point in person or using a sensor, or through remote sensing (aircraft or satellite).

Confine – to restrict a wildfire to a defined area by using a combination of natural and constructed barriers that will stop the spread of the fire under the prevailing and forecasted weather conditions until out. This means that “some action is or has been taken” (line construction, bucket drops, etc.) to suppress portions of the fire perimeter.

Point zone protection – Point or zone protection involves protecting specific points from the fire while not actively trying to line the entire fire edge. Points being protected may be communities, individual homes, communication sites, areas of high resource value, etc.

Full suppression – a strategy to put the fire out as efficiently and effectively as possible, while providing for firefighter and public safety. To complete a fireline around a fire to halt fire spread, and cool down all hot spots that are an immediate threat to the control line or outside the perimeter, until the lines can reasonably be expected to hold under foreseeable conditions. Synonymous with “full perimeter containment” and “control.”

Fiscal year (FY)

October 1 to September 30. The fiscal year is referred to by the calendar year beginning January 1. For example, October 1, 2017, to September 30, 2018, is referred to as Fiscal Year 2018.

Floodplain

The flat area of land adjacent to a river channel that is composed of unconsolidated sediments (alluvium) deposited when the river overflows its banks at flood stages.

Focal species

A small subset of species whose status infers the integrity of the large ecological system to which it belongs and provides meaningful information regarding the effectiveness of the plan in maintaining or restoring the ecological conditions to maintain the diversity of plant and animal communities in the plan area.

Forage

All browse and herbaceous foods that are available to grazing animals.

Forb

Any herbaceous flowering plant other than grasses.

Foreground

A term used in scenery management to describe the portions of a view between the observer and as far as one-quarter to one-half mile distant.

Forested land

Land at least 10 percent occupied by forest trees of any size, or formed having had such tree cover and not currently developed for nonforest use. Lands developed for nonforest use include areas for crops, improved pasture, residential or administrative areas, improved roads of any width, and adjoining road clearing and power line clearing of any width.

Forest health

The perceived condition of a forest derived from concerns about such factors as its age, structure, composition, function, and vigor, presence of unusual levels of insects and diseases, and resilience to disturbance.

Forest plan

Source of management direction for an individual national forest that specifies activity and output levels for a period of time. Management direction in the plan is based on the issues identified at the time of the plan’s development.

Forest plan revision

The process for revising a forest plan includes preliminary identification of the need to change the plan based on the assessment, development of a proposed plan, consideration of the environmental effects of the proposal and preparation of a draft environmental impact statement, providing an opportunity for the public to comment on the proposed plan, providing an opportunity for the public to object before the proposal is approved, and finally, approval of the plan and preparation of the final environmental impact statement.

Fragmentation

A process that occurs wherever a large, contiguous habitat is transformed into smaller patches that are isolated from each other by a landscape matrix unlike the original. This matrix can differ from the original habitat in either composition or structure. The crucial point is that it functions as either a partial or total barrier to dispersal for species associated with the original habitat. A clear threat to population viability occurs when fragmentation isolates pairs and populations, as opposed to fragmentation within the home range of individual pairs.

Frissell-Cole

Condition class campsite monitoring system based on comparing observed site conditions to pre-determined descriptive condition classes. The system consists of descriptions of five condition states that are based on the extent of vegetation damage, mineral soil exposure, tree root exposure, erosion, and tree mortality.

Frissell-Cole Condition Class Rating		
Condition Class	**Visible Indicators**	**Management**
1	Ground vegetation flattened, but not permanently injured. Minimal physical change except for possibly a simple rock fireplace.	These sites are barely recognizable as camping areas. If not in situations known to be sensitive to use (e.g., wet or slump areas), no management action is necessary. Maintain current use or allow increase if other sites must be closed.
2	Ground vegetation worn away around fireplace or center of activity.	Site change now apparent, but still within acceptable limits. These areas are readily identifiable as campsites and will continue to attract use. Future use should be carefully monitored to detect adverse change.
3	Ground vegetation lost on most of the site, but humans and litter still present in all but a few areas.	A transitional condition. Considerable change in plant cover is evident, but few signs of soil problems exist. This condition might be accepted as normal in high use areas. Modification of current use patterns and intensities may be necessary to prevent further change.
4	Bare mineral soil widespread. Tree roots exposed on the surface.	Accelerated deterioration. If current level and type of use continues, soil erosion, loss of tree cover, and aesthetic degradation are likely. Limit use of these sites to allow for recovery. Consider artificial rehabilitation. If site is improperly located, permanent closure should be considered. If site is reopened, ensure that use patterns are adjusted to prevent deterioration to occur again.
5	Soil erosion obvious. Trees reduced in vigor, or dead.	Natural recovery will be extremely slow. Sites should be closed permanently and alternate sites located and used instead. If the site is crucial to recreation use patterns, extensive rehabilitation will be required to return the site to an acceptable condition.

Fry

The life stage of fish species that refers to the juvenile fish in their first few months.

Fuel

Organic material that will support the start and spread of a fire: duff, litter, grass, weeds, forbs, brush, trees, and dead wood materials.

Fuel load

The amount of fuel present expressed quantitatively in terms of weight of fuel per unit area. This may be available (consumable) fuel or total fuel and is typically dry weight.

Fuels management

The manipulation of vegetation for the purpose of changing the characteristics of a fire as it burns.

Fuels reduction treatment

Manipulation or removal of fuels to lessen potential damage and resistance to control (includes mechanical and prescribed fire treatments). Fuels reduction treatments result in a change in the amount, configuration, and spacing of live and dead vegetation, with the purpose of creating conditions that result in more manageable fire behavior and reduced severity during wildfires.

Fuelwood

Round, split, or sawed wood of general refuse material, which is cut into short lengths for burning as fuel.

G

Game species

Any species of wildlife or fish for which hunting seasons and bag limits have been established, and are normally harvested by hunters and fishermen.

General Mining Act of 1872

Provides for claiming and gaining title to locatable minerals on public lands. Also referred to as the “general mining laws” or “mining laws.”

Geographic area

A spatially contiguous land area identified within the planning area. A geographic area may overlap with management areas.

Geographic information system (GIS)

An information processing technology to input, store, manipulate, analyze, and display spatial resource data to support the decision-making processes of an organization. Generally, an electronic medium for processing map information.

Goal

A concise statement that describes a desired condition to be achieved sometime in the future. It is normally expressed in broad, general terms, and is timeless in that it has no specific date by which it is to be completed. Goal statements form the principal basis from which objectives are developed. (36 CFR 219.3)

Graminoids

Graminoids are plants with narrow leaves growing from the base. Forbs are broad-leaved herbs other than grasses.

Grass/forb

An early forest successional stage during which grasses and forbs are the dominant vegetation.

Ground cover

In soil conservation, grasses or other plants grown to keep soil from being blown or washed away. In horticulture, low growing plants such as vinca and ginger that do not require mowing.

Groundwater

Water within the earth that supplies wells and springs. Specifically, water in the zone of saturation where all openings in soil and rock are filled. The upper surface level forms the water table.

Groundwater dependent ecosystem

A community of plants, animals, and other organisms whose extent and life processes depend on groundwater. Examples include many wetlands, groundwater-fed lakes and streams, springs, seeps, and fens.

Group selection

A method of regenerating uneven-aged stands in which trees are cut, in small groups, and new age classes are established. The width of groups is commonly approximately twice the height of the mature trees, with small openings providing suitable microclimates for shade-tolerant tree species to regenerate, and the larger openings providing suitable microclimates for more shade-intolerant tree species to regenerate.

Group use

An activity conducted on National Forest System lands that involves a group of 75 or more people, either as participants or spectators (36 CFR 251.51).

Guideline

A constraint on project or activity decision-making that allows for departure from its terms, so long as the purpose of the guideline is met. Guidelines are intended to help achieve or maintain a desired condition or conditions, avoid or mitigate undesirable effects, or meet applicable legal requirements.

H

Habitat

The natural environment of a plant or animal. In wildlife management, the major components of habitat are considered to be food, water, cover, and living space.

Hazard fuel

A fuel complex defined by kind, arrangement, volume, condition, and location that presents a threat of ignition and resistance to control.

Healthy ecosystem

An ecosystem in which structure and functions allow the maintenance of biological diversity, biotic integrity, and ecological processes over time.

Herbaceous

Of, denoting, or relating to herbs.

Heritage resources

Buildings, sites, areas, architecture, memorials, and objects having scientific, prehistoric, historic, or social values.

Heterogeneity

Composition from dissimilar parts.

Hibernacula

Habitat niches where certain animals, e.g., bats, over-winter, such as caves, mines, tree hollows, or loose bark.

Historic property

Any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register of Historic Places. This term includes artifacts, records, and remains that are related to and located within such properties. The term also includes properties of traditional religious and cultural importance to an Indian tribe or Native Hawaiian organization and that meet the National Register criteria.

Hydrologic unit code

A sequence of numbers that identifies a hydrologic feature like a river, river reach, lake, or area like a drainage basin, watershed, or catchment.

Hydrophobic

Water repellent, having little or no affinity with water.

I

Ignition

The initiation of combustion.

IMPLAN

Acronym for the computer model used as an analysis tool to display social effects of various alternatives developed during the land management planning effort.

Indicator species

Species identified in the planning process that are used to monitor the effects of planned management activities on viable populations of wildlife and fish species, including those species that are socially or economically important.

Indirect effects

Results of an action occurring at a location other than where the action took place and/or later in time, but in the reasonable foreseeable future. Indirect effects may include growth-inducing effects and other effects related to induced changes in the pattern of land use, population density, or growth rate, and related effects on air and water and other natural systems, including ecosystems.

INFRA

INFRA is a collection of web-based data entry forms, reporting tools, and GIS tools that enable the Forest Service to manage and report accurate information about the inventory of constructed features and land units as well as the permits sold to the public and to partners.

Infrastructure

The facilities, utilities, and transportation system needed to meet public and administrative needs for operation, e.g., buildings, roads, and power supplies.

Inholding

Land within the proclaimed boundaries of a national forest that is owned by a private citizen, an organization, or an agency.

Instream flow

The volume of surface water in a stream system passing a given point at a given time.

Interdisciplinary team

A group of individuals with different training assembled to solve a problem or perform a task. The team is assembled out of recognition that no one scientific discipline is sufficiently broad enough to adequately solve the problem.

Intermittent stream

A stream or reach of stream channel that flows, in its natural condition, only during certain times of the year or in several years. 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 (Briggs 1996).

Interpretation

Explaining the meaning or significance of something.

Invasive species

Native species are those that have occurred, now occur, or may occur in a given area as a result of natural processes.

Exotic (a.k.a. nonnative, foreign, or alien) species are those that live outside their native range and arrived there by human activity, either deliberate or accidental.

Invasive species have the ability to thrive and spread aggressively outside their natural range. They affect both aquatic and terrestrial areas and can be plants, vertebrates, invertebrates, and pathogens.

Invertebrate

An animal lacking a spinal column.

Irretrievable

Applies to losses of production, harvest, or uses of renewable natural resources. For example, some or all of the timber production from an area is irretrievably lost while an area is used as a road surface. If the use is changed, timber production can be resumed. The production lost is irretrievable, but the action is not irreversible.

Irreversible

Applies primarily to the use of nonrenewable resources, such as minerals or cultural resources, or to those factors that are renewable only over long time spans, such as soil productivity. Irreversible also includes loss of future options.

K

Keystone species

A species that has a disproportionately large effect on the communities in which it occurs. Such species help to maintain local biodiversity within a community either by controlling populations of other species that would otherwise dominate the community or by providing critical resources for a wide range of species.

Krummholz

Stunted trees near timberline.

L

Lagomorph

The taxonomic order Lagomorpha includes the relatively well-known rabbits and hares (family Leporidae) and also the less frequently encountered pikas (family Ochotonidae). Rabbits and hares characteristically have long ears, a short tail, and strong hind limbs that provide a bounding locomotion. In contrast, the smaller pikas have shorter, rounded ears, no external tail, and less-well-developed hind limbs associated with scampering locomotion.

Land exchange

The conveyance of non-Federal land or interests to the United States in exchange for National Forest System land or interests in land.

Landscape

A 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.

Landscape scale

A heterogeneous land area composed of a cluster of interacting ecosystems that are repeated in similar form throughout. Landscapes vary in size, from many thousands of acres to only a few kilometers in diameter.

Landslide

The moderately rapid to rapid downslope movement of soil and rock that may or may not be water-saturated.

Late-successional forest

A stage of forest succession where the majority of trees are mature or overmature.

Large woody debris

Large pieces of relatively stable woody material located within the bankfull channel and appearing to influence bankfull flows.

Single – A single piece that has a length equal to or greater than 3 meters or two-thirds of the wetted stream width and 10 centimeters in diameter one-third of the way from the base.

Aggregate – Two or more clumped pieces, each of which qualifies as a single piece.

Rootwad – Rootmass or boles attached to a log less than 3 meters in length.

Latilla

One of a number of sticks or small branches, typically of stripped pine, cedar, or aspen, laid across the main vigas (beams) to form a ceiling.

Leasable minerals

Those minerals or materials designated as leasable under the Minerals Leasing Act of 1920. They include coal, phosphate, asphalt, sulfur, potassium, sodium minerals, and oil and gas. Geothermal resources are also leasable under the Geothermal Steam Act of 1970.

Lease

A legal contract that provides for the right to develop and produce oil and gas resources for a specific period of time under certain agreed-upon terms and conditions.

Leave tree

A tree marked to be left standing in an area where it would otherwise be felled.

Lek

The name of an area where sage-grouse congregate in the spring. Because the males choose an area where their courtship display can be easily seen by females, leks are generally found where there is less vegetation. These areas may be sparsely vegetated naturally, or due to activity by animals or humans.

Leaf litter

A surface layer of loose organic debris, consisting of freshly fallen or slightly decomposed organic materials.

Locatable minerals

Minerals or materials subject to claim and development under the Mining Law of 1872, as amended. Generally includes metallic minerals such as gold and silver, and other materials not subject to lease or sale, like some bentonites, limestone, talc, some zeolites, etc.

Long-term effects

A relative indicator as to the duration of an impact or change; the effects last longer than the period of time that is considered reasonable for recovery. An effect is long term when it persists through or beyond the natural lifetime of an individual.

Lynx analysis unit

An area of at least the size used by an individual lynx, from about 25 to 50 square miles.

M

M

1,000 units (thousands)

Maintenance

The upkeep of the entire Forest Development Transportation Facility, including surfaces and shoulders, parking and side areas, structures, and such traffic control devices as are necessary for its safe and efficient use (36 CFR 212.1). Maintenance is not for the purpose of upgrading a facility, but to bring it to the originally constructed or subsequently reconstructed conditions.

Maintenance level

The level of service provided by, and maintenance required for, a specific road. For more information, see the entry for **road maintenance level**.

Management action or activity

An action or activity humans impose on a landscape for the purpose of managing natural resources.

Management approach

Management approaches describe the principal strategies and program priorities the responsible official intends to employ to carry out projects and activities developed under the plan. They can convey a sense of priority and focus among objectives and likely management emphasis. They are optional plan content.

Management area

A land area identified within the planning are that has the same set of applicable plan components. A management area does not have to spatially contiguous.

Management concern

An issue, problem, or a condition that constrains the range of management practices identified by the Forest Service in the planning process. (36 CFR 219.3)

Management direction

A statement of multiple-use and other goals and objectives, the associated management prescriptions, and standards and guidelines for attaining them. (36 CFR 219.3)

Management prescription

Management practices and intensity selected and scheduled for application on a specific area to attain multiple use and other goals and objectives. (36 CFR 219.3)

Mass movement

Downslope unit movement of a portion of the land surface. A single landslide of the gradual, simultaneous downhill movement of the entire mass of loose earth material on a slope face.

MBF

One thousand board feet of timber.

Mechanical treatment

Mechanical vegetation treatment is any activity undertaken to modify the existing condition of the vegetation accomplished with mechanical equipment.

Mechanized

Wheeled forms of transportation, including nonmotorized carts, wheelbarrows, bicycles, and any other nonmotorized, wheeled vehicle.

Memorandum of understanding

A legal agreement between the Forest Service and other agencies resulting from consultation between agencies that states specific measures the agencies will follow to accomplish a large or complex project. A memorandum of understanding is not a fund-obligating document.

Metapopulation

A group of populations separated by space but that consist of the same species. These spatially separated populations interact as individual members move from one population to another.

Middleground

A term used in scenery management to describe the portions of a view extending from the foreground zone out to 3 to 5 miles from the observer.

Migration route

Route followed by an animal species during periods of annual movement, usually between summer and winter ranges.

Mineral

Locatable – Hard rock minerals that are mined and processed for the recovery of metals. They may include certain nonmetallic minerals and uncommon varieties of mineral materials such as valuable and distinctive deposits of limestone or silica.

Leasable – Coal, oil, gas, phosphate, sodium, potassium, oil shale, sulfur, and geothermal resources.

Salable (or mineral materials) – A collective term to describe common varieties of sand, gravel, stone, pumice, cinders, clay, and other similar materials. Common varieties do not include deposits of those materials that may be locatable.

Mineral development

The activities and facilities associated with extracting mineral deposits.

Mineral entry

Claiming public lands administered by the Forest Service under the Mining Law of 1872 for the purpose of exploiting minerals. May also refer to mineral exploration and development under the mineral leasing laws and Material Sale Act of 1947.

Mineral estate (mineral rights)

The ownership of minerals, including rights necessary for access, exploration, development, mining ore dressing, and transportation operations.

Mineral potential

The classification of lands according to the probability of undiscovered mineral resources, delineated as to the type of mineral, the extent of the expected deposit, and the likelihood of its occurrence. The likelihood of occurrence for oil and gas is classified as follows:

High Potential: Describes a geologic environment that is highly favorable for discovering oil and gas resources. The area is on or near a producing field and evidence exists that the geologic conditions of reservoir, source, and trap necessary for the accumulation of oil and gas are present.

Moderate Potential: Refers to an environment that is favorable for the occurrence of undiscovered oil and gas resources; however, one of the geologic conditions necessary for the accumulation of oil or gas may be absent.

Low Potential: Refers to an environment that is not favorable for the accumulation of oil and gas as indicated by geologic, geochemical, and geophysical characteristics. Evidence exists that one of the geologic conditions necessary for the accumulation of oil or gas is absent.

Unknown Potential: Refers to a region for which geologic information is insufficient to otherwise categorize potential. This category should be limited to specific areas for which there is a true lack of data and should not be used as a substitute for performing the interpretation.

Mineral withdrawal

The exclusion of locatable mineral deposits from mineral entry on areas required for administrative sites by the Forest Service, and other areas highly valued by the public. Public lands withdrawn from entry under the General Mining Laws and/or the Mineral Leasing Laws.

Minimum stocking standard

The stocking that must be present on regenerated areas before a new stand can be considered established. Minimum stocking is generally stated in terms of number of trees per acre and tree-stem heights by species.

Mining

Extraction of valuable minerals or other geological materials from the earth.

Mining Act of 1872

Provides for claiming and gaining title to locatable minerals on public lands. Officially known as the “General Mining Act of 1872,” but also informally referred to as the “general mining laws” or “mining laws.”

Mitigate (Mitigation)

To avoid, minimize, rectify, reduce, or compensate the adverse environmental impacts associated with an action.

MM

1,000,000 units.

MMBF

1,000,000 board feet of timber.

Modification

A description in scenic quality objectives when activities may dominate, but must use naturally established form, color, and texture. These areas should appear natural when viewed in the background.

Monitoring

A systematic process of collecting information to evaluate effects of actions or changes in conditions or relationships.

Montane

Of or inhabiting mountainous country.

Mosaic

The intermingling of plant communities and their successional stages in such a manner as to give the impression of an interwoven design.

Motorized equipment

A machine that uses a motor, engine, or other nonliving power source. This includes, but is not limited to, machines such as chain saws, aircraft, snowmobiles, generators, motorboats, and motor vehicles. It does not include small battery or gas powered hand carried devices such as shavers, wristwatches, flashlights, cameras, stoves, or other similar small equipment.

Motorized route

A National Forest System road or trail that is designated for motorized use on a motor vehicle use map pursuant to 36 CFR 212.51.

Motorized use

The designation of roads, trails, and areas that are open to motor vehicle use as specified in the Federal Register / Vol. 70, No. 216 / Wednesday, November 9, 2005 / 36 CFR Parts 212, 251, 261, Travel Management; Designated Routes and Areas for Motor Vehicle Use; Final Rule.

Motor vehicle use map

A map reflecting designated roads, trails, and areas open to motorized public use on an administrative unit or a ranger district of the National Forest System.

Multiple use

The management of all the various renewable surface resources of the national forests 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 the use to conform to changing needs and conditions; that some lands 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. (36 CFR 219.19)

N

National Environmental Policy Act (NEPA)

A 1969 act declaring a national policy that encourages productive and enjoyable harmony between humankind and the environment, to promote efforts that will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of humanity, to enrich the understanding of the ecological systems and natural resources important to the nation, and to establish a Council on Environmental Quality. (The Principal Laws Relating to Forest Service Activities, Agriculture Handbook No. 453, USDA, Forest Service, 359 pp.) The NEPA process is an interdisciplinary process that concentrates decision-making around issues, concerns, alternatives, and the effects of alternatives on the environment. NEPA regulations are set out in Forest Service Handbook 1909.15.

National Forest Management Act

A law passed in 1976 as an amendment to the Forest and Rangeland Renewable Resources Planning Act, requiring the preparation of Regional Guides and Forest Plans, and the preparation of regulations to guide that development.

National Forest System lands

All national forest lands reserved or withdrawn from the public domain of the United States, all national forest lands acquired through purchase, exchange, donation, or other means, the national grasslands and land utilization projects administered under title III of the Bankhead-Jones Farm Tenant Act (50 Stat. 525, 7 USC 1010-1012), and other lands, waters, or interests therein which are administered by the Forest Service or are designated for administration through the Forest Service as a part of the system. 16 USC 1609(a).

National Historic Preservation Act

Extends the policy in the Historic Sites Act to State and local historical sites as well as those of national significance, expands the National Register of Historic Places, establishes the Advisory Council on Historic Preservation and the State Historic Preservation Officers, and requires agencies to designate Federal Preservation Officers. Section 106 directs all Federal agencies to take into account the effects of their undertakings (actions, financial support, and authorizations) on historic properties included in or eligible for the National Register. Section 110 establishes inventory, nomination, protection, and preservation responsibilities for federally owned historic properties.

National Register of Historic Places

The Nation's official list of cultural resources worthy of preservation. Authorized under the National Historic Preservation Act of 1966, the National Register is part of a national program to coordinate and support public and private efforts to identify, evaluate, and protect our historic and archaeological resources. Properties listed in the Register include districts, sites, buildings, structures, and objects that are significant in American history, architecture, archaeology, engineering, and culture. The National Register is administered by the National Park Service.

Native American Graves Protection and Repatriation Act (NAGPRA)

Provides a process for museums and Federal agencies to return certain Native American cultural items—human remains, funerary objects, sacred objects, or objects of cultural patrimony—to lineal descendants, and culturally affiliated Indian tribes and Native Hawaiian organizations. NAGPRA includes provisions for unclaimed and culturally unidentifiable Native American cultural items, intentional excavation, and unanticipated discovery of Native American cultural items on Federal and Tribal lands, and penalties for noncompliance and illegal trafficking. The Act requires agencies and museums to identify holdings of such remains and objects and to work with appropriate Native American groups toward their repatriation. Permits for the excavation and/or removal of “cultural items” protected by the Act require Tribal consultation, as do discoveries of “cultural items” made during activities on Federal or Tribal lands.

Natural range of variation

The variation of ecological characteristics and processes over scales of time and space that are appropriate for a given management application. In contrast to the generality of historical ecology, the natural range of variation concept focuses on a distilled subset of past ecological knowledge developed for use by resource managers; it represents an elicit effort to incorporate a past perspective into management and conservation decisions. The pre-European influenced reference period considered should be sufficiently long, often several centuries’, to include the full range of variation produced by dominant natural disturbance regimes such as fire and flooding and should also include short-term variation and cycles in climate. The natural range of variation is a tool for assessing the ecological integrity and does not necessarily constitute a management target or desired condition. The natural range of variation can help identify key structural, functional, compositional, and connectivity characteristics, for which plan components may be important for either maintenance or restoration of such ecological conditions.

Nonmotorized activities

Activities that do not incorporate the use of a motor, engine, or other nonliving power source. This includes such machines as aircraft, hovercraft, motorboats, automobiles, motor bikes, snowmobiles, bulldozers, chainsaws, rock drills, and generators.

No surface occupancy (NSO)

A fluid mineral leasing stipulation that prohibits occupancy or disturbance on all or part of the land surface to protect special values or uses. The NSO stipulation includes stipulations that may have been worded as “no surface use/occupancy,” “no surface disturbance,” “conditional NSO,” and “surface disturbance or surface occupancy restriction (by location).” Lessee may exploit the oil and gas or geothermal resources under leases restricted by this stipulation through use of directional drilling from sites outside the NSO area.

Notice of intent

Written notice to announce the Forest Service’s intent to begin forest plan revision and prepare an environmental impact statement.

O

Objective

A concise, measureable, and time-specific statement of a desired rate of progress toward a desired condition or conditions. Objectives should be based on reasonable foreseeable budgets.

Off-highway vehicle

Any motor vehicle designed for or capable of cross-country travel on or immediately over land, water, sand, snow, ice, marsh, swampland, or other natural terrain. It includes, but is not limited to, four-wheel drive or low-pressure-tire vehicles, motorcycles and related two-wheel vehicles, amphibious machines, and ground-effect or air-cushion vehicles.

Old forest

The overstory is dominated by late seral or climax species of a certain age and size, and has other characteristics such as snags, canopy layers, downed woody material, and trees with rotten, dead, or broken tops**.**

Old forest habitat

Habitat for certain wildlife that is characterized by late-successional forest stands with large snags and decaying logs.

Openings

Meadows, clearcuts, and other areas of vegetation that do not provide cover.

Ore

A type of rock that contains sufficient minerals with important elements, including metals that can be economically extracted from the rock. The ores are extracted from the earth through mining; they are then refined, often via smelting, to extract the valuable element or elements.

Organic matter

In soil, the organic fraction that includes plant and animal residues at various stages of decomposition, cells and tissues of soil organisms, and substances synthesized by the soil population; commonly determined as the amount of organic material contained in a soil sample passed through a 2-millimeter sieve.

Oshá

Oshá, also known as osha (*Ligusticum porteri*), is a perennial herb found in parts of the Rocky Mountains and northern Mexico, especially in the southwestern United States. Oshá is strictly a mountain plant that requires partial shade. It is most commonly found in deep, moist soils rich in organic material.

Outputs

The goods, end products, or services that are purchased, consumed, or used directly by people. Goods, services, products, and concerns produced by activities that are measurable and capable of being used to determine the effectiveness of programs and activities in meeting objectives.

Overstory

That portion of a plant community consisting of the taller plants on the site; the forest or woodland canopy.

Over-the-snow vehicle

Vehicles that are designed for use over snow and that run on a track or tracks and/or a ski or skis, while in use over snow.

P

Party

A group of people readily recognized as traveling together.

Payment(s) in Lieu of Taxes (PILT)

A law that provides compensation to counties for loss of county tax revenue from the Federal (nontaxable) land within their boundaries. Payments are based on the acreage of Federal land within each county. Payments must be authorized annually by Congress and are distributed through the Department of Interior, Bureau of Land Management.

Payments to States (25-Percent Fund)

A law that provides 25 percent of the gross receipts from the sale of timber, grazing, recreational activities, and other uses on Forest Service System lands, which are returned to states to be used for roads and schools in the counties where the lands are located. Each county's share of the 25-Percent payment is based on the percentage of National Forest System acreage within that county.

Peak flow

The highest discharge of water recorded over a specified period of time at a given stream location. Often thought of in terms of spring snowmelt.

Perennial stream

A 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.

Persons at one time (PAOT)

A recreational capacity measurement term indicating the number of people who can use a facility or area at one time. Equal to five persons per family unit for camp and picnic grounds.

Planned ignition

The intentional initiation of a wildland fire by a hand-held, mechanical, or aerial device where the distance and timing between ignition lines or points and the sequence of igniting them is determined by environmental conditions (weather, fuel, topography), firing technique, and other factors that influence fire behavior and fire effects (see prescribed fire).

Planning period

The lifetime of the plan. The time interval within the planning horizon that is used to show incremental changes in yields, costs, effects, and benefits.

Planning Rule

The 2012 Planning rule provides the overarching framework for individual forests and grasslands in the National Forest System to use in developing, amending, and revising land management plans, which are also known as forest plans. The planning rule identifies a framework for revising land management plans that consists of three phases: assessment, plan revision, and monitoring.

The Forest Service is required by statute to have a national planning rule: the Forest and Rangeland Renewable Resources Planning Act of 1974, as amended by the National Forest Management Act of 1976, requires the Secretary of Agriculture to issue regulations under the principles of the Multiple-Use Sustained-Yield Act of 1960 for the development and revision of land management plans.

Plant associations

A grouping of plants that have reached dynamic equilibrium with the local environmental conditions, equivalent to climax. Onsite there is no evidence of replacement by other dominant plant species and there is no evidence of serious disturbance.

Plant community

Any assemblage of plants that occur in the same area and form a distinct ecological unit.

Pole or pole timber

Smaller diameter trees larger than saplings that do not meet the specifications for sawtimber.

Population viability

Ability of a population to sustain itself.

Precambrian

The period of geologic time before the Cambrian Period, extending from 542 million years ago to about 4.6 billion years ago, when Earth began to form.

Pre-commercial thinning

Cutting non-sawtimber trees to meet a variety of management objectives including improving tree vigor, stand species composition, wildlife habitat, or reducing fuels.

Prescribed fire

A wildland fire originating from a planned ignition to meet specific objectives identified in a written, approved, prescribed fire plan for which National Environmental Policy Act requirements (where applicable) have been met prior to ignition (see planned ignition).

Prescription

Management practices selected and scheduled for application on a specific area to attain goals and objectives.

Preservation

A scenic condition objective in which only ecological changes are allowed. Management activities, except for low impact recreation facilities, are prohibited. This objective applies mainly to wilderness, primitive areas, and areas with special classifications. Also, a technique of conservation that maintains the resource in or on the ground into perpetuity.

Primitive road

A road constructed with no regard for grade control or designed drainage, sometimes by merely repeatedly driving over an area. These roads are of single lane, typically with native surfacing, and sometimes usable with 4-wheel-drive vehicles only.

Priority heritage asset

A historic property that meets the criteria for a priority heritage asset with a current documented condition assessment and a recommended management use that realizes its agency and public benefit(s).

Productive

The ability of an area to provide goods and services and sustain ecological values.

Projected timber sale quantity (PTSQ)

The estimated quantity of timber meeting applicable utilization standards that is expected to be sold during the plan period. As a subset of the projected wood sale quantity (PWSQ), the projected timber sale quantity includes volume from timber harvest for any purpose from all lands in the plan area based on expected harvests that would be consistent with the plan components. The PTSQ is also based on the planning unit’s fiscal capability and organizational capacity. PTSQ is not a target nor a limitation on harvest, and is not an objective unless the responsible official chooses to make it an objective in the plan.

Projected wood sale quantity (PWSQ)

The estimated quantity of timber and all other wood products that is expected to be sold from the plan area for the plan period. The PWSQ consists of the projected timber sale quantity as well as other woody material such as fuelwood, firewood, or biomass that is also expected to be available for sale. The PWSQ includes volume from timber harvest for any purpose based on expected harvests that would be consistent with the plan components. The PWSQ is also based on the planning unit’s fiscal capability and organizational capacity. PWSQ is not a target nor a limitation on harvest, and is not an objective unless the responsible official chooses to make it an objective in the plan.

Project record

The documents and materials considered in the making of a forest plan, plan revision, or plan amendment. Also known as the planning record.

Proposed action

In terms of the National Environmental Policy Act (NEPA), the project, activity, or decision that a Federal agency intends to implement or undertake, which is the subject of an environmental impact statement or environmental assessment.

Public access

Generally refers to a road or trail route over which a public agency claims right-of-way for public use.

Public participation

Meetings, conferences, seminars, workshops, tours, written comments, responses to survey questionnaires, and similar activities designed and held to obtain comments from the public about Forest Service planning.

Proposed species

Any species that is proposed by the U.S. Fish and Wildlife Service or National Marine Fisheries Service to be listed as threatened or endangered under the Endangered Species Act.

R

Range allotment

Rangelands are managed as allotments and pastures. An allotment is a designated area of land available for permitted livestock grazing. Grazing is authorized for a specified number and kind of livestock. It is the basic land unit used to facilitate management of the range resource on National Forest System lands administered by the Forest Service.

Range condition

The state of the plant community on a range site in relation to the potential natural community or the desired plant community for that site. It is typically rated in the general category of satisfactory or unsatisfactory.

Rangeland

Land on which vegetation is predominantly grasses, forbs, or shrubs suitable for grazing or browsing. Rangeland may include some forest and barren land.

Ranger district

Administrative subdivision of a national forest, supervised by a district ranger who reports to the forest supervisor.

Reclamation

Returning disturbed lands to a form and productivity that will be ecologically balanced and in conformity with a predetermined land management plan.

Reconstruction

Activities performed on an existing road or other facility to restore it to a specified standard.

Record of decision

A document prepared as a public record of decision in cases requiring an environmental impact statement.

Recreation event

A recreational activity conducted on National Forest System lands for which an entry or participation fee is charged, such as animal, vehicle, or boat races; dog trials; fishing contests; rodeos; adventure games; and fairs.

Recreation opportunity spectrum (ROS)

Allocations that identify a variety of recreation experience opportunities categorized into six classes on a scale from primitive to urban. Each class is defined in terms of the degree to which it satisfies certain recreation experience needs, based on the extent to which the natural environment has been modified, the type of facilities provided, the degree of outdoor skills needed to enjoy the area, and the relative density of recreation use. The six classes are:

Primitive – Very high probability of experiencing solitude, self-reliance, and challenge; natural landscape with natural processes allowed to function; very low interaction between users; restrictions and controls not evident; access limited; generally cross-country travel.

Semiprimitive nonmotorized – Good probability of experiencing solitude, self-reliance, and challenges; natural primitive landscapes; some evidence of users; minimum subtle controls; access by low standard trails and cross-country travel; natural processes allowed to function with subtle vegetative alterations. Managed for nonmotorized use.

Semiprimitive motorized – Moderate probability for self-reliance and experiencing solitude away from travelways (roads/trails); risk associated with motorized equipment; predominantly natural landscapes; low concentration of users and interaction by users along travelways; minimum but subtle restrictions; vegetative alterations visually blend with the landscape. Existing routes are designated for off highway vehicles and other high clearance vehicles. Mountain bikes and other mechanized equipment are present.

Roaded natural – Low opportunity to avoid other users; little opportunity for risk or challenge; substantial modified landscapes; moderate evidence and interaction of users; controls and restrictions present; variety of motorized users and access; various shapes and sizes of vegetative alterations that blend with the landscape. The road system is well defined and can accommodate sedan travel.

Rural – Good opportunity to affiliate with others; facilities important; self-reliance of little importance; altered landscapes but attractive; high interaction among users; obvious and prevalent controls; extensive motorized use; vegetation maintained. Rural settings represent most developed recreation sites.

Urban – Opportunity to affiliate with others important; outdoor skills associated with competitive events; landscapes extensively changed with dominant structures; large numbers of user interactions; intensive controls are numerous; motorized use prevalent, including mass transit; vegetation planted and maintained. Highly developed ski areas and resorts are examples of a typical urban setting on National Forest System lands.

Recreational livestock use

The use of an area by domesticated animals such as horses, mules, pack goats, and llamas, which are used primarily in conjunction with recreation activities.

Recreation setting

The social, managerial, and physical attributes of a place that, when combined, provide a distinct set of recreation opportunities. The Forest Service uses the recreation opportunity spectrum to define recreation settings and categorize them into six distinct classes: primitive, semiprimitive nonmotorized, semiprimitive motorized, roaded natural, rural, and urban.

Recreation site

A defined, public recreation area. The Forest Service uses two categories for recreation sites: dispersed and developed. Both types may have improvements needed to protect resources such as signs, road closure devices, bear resistant food storage devices, and/or sanitation facilities. Some recreation sites are designed and managed for overnight use and some are designed and managed for day-use only (e.g., interpretive signs at roadside pull-outs, trailheads at roadside pull-outs or at road closures, picnic areas or boat launches that are closed at night, ski areas that do not have overnight lodging).

Developed sites have agency improvements made out of manmade materials that are intended to provide for public recreation and user comfort/convenience. Examples on National Forest Service lands include, but are not limited to: ski areas, campgrounds, sites with cabins, huts, lodges, recreation residences, visitor centers, and trailheads.

Dispersed sites have minimal to no agency improvements made out of manmade materials. Dispersed sites may include outfitter camps or other primitive camping spots along a road, trail, or water body, or at a road closure.

Reforestation

Management activities used to increase or accelerate the establishment of forest cover to meet resource objectives.

Regeneration

Natural – A group or stand of young trees created from germination of seeds from trees on the site or sprouting from trees on the site.

Artificial – A group or stand of young trees created by direct seeding or by planting seedlings or cuttings.

Regeneration harvest

Timber harvest system intended to create a new age class (see regeneration method).

Regeneration method

A cutting procedure by which a new age class is created. The major methods are clearcutting, seed-tree, shelterwood, selection, and coppice. Regeneration methods are grouped into four categories: coppice, even-aged, two-aged, and uneven-aged.

Region

An administrative unit within the National Forest System based on geographical location. Each of the nine Forest Service regional offices is supervised by a regional forester. The Rio Grande National Forest is part of the Rocky Mountain Region, also known as Region 2. The Rocky Mountain Regional Office is strategically located in Lakewood, Colorado, between the foothills of the Rocky Mountains and downtown Denver.

Rehabilitation

1) Actions taken to protect or enhance site productivity, water quality, or other values for a short period of time.
2) A short-term scenic condition objective used to restore landscapes containing undesirable visual or other resource impacts to the desired scenic or other acceptable quality level.

Research natural area (RNA)

Designated areas of land established by the Chief of the Forest Service under 36 CFR 251.23 for research and educational purposes and to typify important forest and range types of the Forest, as well as other plant communities that have special or unique characteristics of scientific interest and importance.

Resilience

The ability of a system to recover from disturbance in the event that the disturbance exceeds the capacity of the system to resist changing. The concepts of resistance and resilience are jointly referred to as resilience.

Resistance

The capacity of ecosystems to tolerate disturbances without exhibiting significant change in structure and composition. The concepts of resistance and resilience are jointly referred to as resilience.

Response to wildland fire

The mobilization of the necessary services and responders to a fire based on ecological, social, and legal consequences, the circumstances under which a fire occurs, and the likely consequences on firefighter and public safety and welfare, natural and cultural resources, and values to be protected.

Responsible official

The Forest Service employee who has the delegated authority to make a specific decision. For example, the regional forester will select the preferred alternative for the forest plan.

Restore/restoration

Assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed. It is an intentional activity that initiates or accelerates the recovery of an ecosystem with respect to its health, integrity, and sustainability.

Revegetation

The reestablishment and development of a plant cover. This may take place naturally through the reproductive processes of the existing flora or artificially through the direct action of reforestation or reseeding.

Right-of-way

Land authorized to be used or occupied for the construction, operation, maintenance, and termination of a project or facility passing over, upon, under, or through such land (36 CFR 251.51). The privilege that one person or persons particularly described may have of passing over the land of another in some particular line (FSH 2709.12 05 10).

Riparian area

A riparian ecosystem is a transition area between the aquatic ecosystem and the adjacent terrestrial ecosystem, identified by soil characteristics or distinctive vegetation communities that require free or unbound water (FS-990A). Riparian areas may be associated with lakes, reservoirs, estuaries, hot springs, marshes, streams, bogs, wet meadows, and intermittent or permanent streams where free and unbound water is available. This habitat is transitional between true bottomland wetlands and upland terrestrial habitats, and while associated with watercourses, may extend inland or upland for considerable distances.

River mile

The measure of distance along a river from its mouth, in miles. River mile numbers begin at zero and increase upstream. The river mile is not the same as the length of the river; rather, it is a means of locating any feature along the river relative to its distance from the mouth, when measured along the course (or navigable channel) of the river.

Road

A motor vehicle route more than 50 inches wide, unless identified and managed as a trail.

Road construction

Activity that results in the addition of system or temporary road miles.

Road corridor

A strip of land between two points used by a road, or some future road whose exact location remains to be determined; generally with an indefinite width.

Road density

The number of road miles per square mile of land (i.e., 1 mile/square mile is 1 mile of road within a given square mile). This includes the total density of primary, secondary, and primitive roads.

Road maintenance level

Defines the level of service provided by, and maintenance required for, a specific road, consistent with road management objectives and maintenance criteria (FSH 7709.58, section 12.3). The maintenance levels are:

Maintenance level 1 – Intermittent service roads during the time they are closed to vehicular traffic. The closure period is 1 year or longer. Basic custodial maintenance is performed.

Maintenance level 2 – Roads open for use by high-clearance vehicles, minor traffic, no warning signs. Passenger car traffic is not a consideration.

Maintenance level 3 – Roads open and maintained for a prudent driver in a standard passenger car, low speed travel, warning signs provided. User comfort and convenience are not considered priorities.

Maintenance level 4 – Roads that provide a moderate degree of user comfort and convenience at moderate travel speeds, single or double lane, aggregate or paved surface.

Maintenance level 5 – Roads that provide a high degree of user comfort and convenience, single or double lane, generally paved surface, or aggregate-surfaced with dust abatement.

Rocky Mountain Region

The Forest Service organizational unit consisting of Colorado, Wyoming, South Dakota, Nebraska, and Kansas. Also called Region 2.

Rotation

The planned number of years between the formation of a generation of trees and its final cutting at a specified stage of maturity.

S

Sacred site

Per Executive Order 13007 – any specific, discrete, narrowly delineated location on Federal land that is identified by an Indian tribe, or Indian individual determined to be an appropriately authoritative representative of an Indian religion, as sacred by virtue of its established religious significance to, or ceremonial use by, an Indian religion; provided that the Indian tribe or appropriately authoritative representative of an Indian religion has informed the agency of the existence of such a site.

Salable minerals

Includes common varieties of sand, stone, gravel, pumice, pumicite, cinders, and clay. In general, these minerals are widely spread and are relatively low in unit value. They are generally used for construction materials and for road building purposes.

Salvage harvest

Removal of trees that are damaged, dead, or dying or being damaged by injurious agents other than competition between trees, such as insect and disease epidemics, wildfire, or storms, to recover timber before it loses its commercial value.

Sanitation cutting

Intermediate harvest to remove trees to improve stand health by stopping or reducing the actual or anticipated spread of insects and diseases.

Sawtimber

Larger diameter trees of sufficient size and quality to be manufactured into dimensional lumber products. Species and minimum diameters of sawtimber trees are established by regional timber markets.

Scale

The degree of resolution at which ecological processes, structures, and changes across space and time are observed and measured.

Scarify

To abrade, scratch, or modify the surface. For example, to break the surface of the soil with a winged-ripper implement.

Scenic character

A 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.

Scenic condition

Measurable standard for scenic resource management based on the acceptable degree of alteration of the characteristic landscape. The acceptable degree of alternation for a given landscape is dictated by the area's scenic integrity objective.

Scenic integrity objective

Scenic integrity objectives serve as the desired conditions for the scenic resources and represent the degree of intactness of positive landscape attributes. Scenic integrity objectives are categorized into five levels. The highest ratings are given to those landscapes where valued landscape attributes will appear complete with little or no visible deviations. Lower ratings are given to those landscapes where modifications will be more evident.

Very high – Landscape is intact with changes resulting primarily through natural processes and disturbance regimes.

High – Management activities are unnoticed and the landscape character appears unaltered.

Moderate – Management activities are noticeable but are subordinate to the landscape character. The landscape appears slightly altered.

Low – Management activities are evident and sometimes dominate the landscape but are designed to blend with surroundings by repeating line, form, color, and texture of valued landscape character attributes. The landscape appears altered.

Very low – Human activities of vegetation and landform alterations may dominate the original, natural landscape character but should appear as natural occurrences when viewed at background distances.

Scenic resource

The composite of basic physiographic features, patterns, and land-use effects that typify a land unit and influence the scenic appeal the unit may have for visitors.

Scoping

Determination of the significant issues to be addressed in an environmental impact statement.

Secure habitat

An area where wildlife retreat for safety when disturbance in their usual range is intensified, such as by logging activities or during hunting seasons.

Sedge

A grass-like plant with triangular stems and inconspicuous flowers, typically growing in wet ground.

Sediment

Material suspended in water or that has been deposited in streams and lakes.

Seedling/sapling

A forest successional stage in which trees are less than 5 inches in diameter.

Sensitive species

Those plant and animal species identified by the regional forester for which population viability is a concern as evidenced by significant current or predicted downward trends in a) population numbers or density, or b) habitat capability that would reduce a species' existing distribution.

Seral

The gradual supplanting of one community of plants by another, the sequence of communities being termed a sere and each stage seral (successional).

Seral stage

A phase in the sequential development of a climax community.

Shelterwood regeneration method with reserves

A regeneration method that creates a two-aged stand in which some or all of the shelter trees are retained to attain goals other than regeneration. The reserve trees generally comprise at least 10 percent of full stocking after the last harvest. Similarly, when the shelterwood regeneration method with reserves is used, there may be one or more harvest entries:

Shelterwood preparatory cut – An optional cut that enhances conditions for seed production and/or develops wind firmness for a future shelterwood establishment cut.

Shelterwood establishment cut – A cut to establish a moderated microenvironment, prepare the seed bed, and create a new age class.

Shelterwood removal with reserves cut – An optional removal cut that releases established regeneration from competition with shelter trees after they are no longer needed for shelter while retaining reserve trees to create a two-aged stand.

Short-term effects

A relative indicator as to the duration of an impact or change. The effect is repairable within a reasonable period of time following the action.

Shrub/seedling

A forest successional stage in which shrubs and seedling trees are the dominant vegetation.

Silvicultural treatment

A forest management activity such as thinning, harvesting, planting, pruning, prescribed burning, and site preparation that is designed to alter the establishment, growth, composition, health, and quality of forests and woodlands to meet the diverse needs and values of landowners and society on a sustainable basis.

Silviculture

The art and science of controlling the establishment, growth, composition, health, and quality of forests and woodlands to meet the diverse needs and values of landowners and society on a sustainable basis.

Single-tree selection regeneration method

An uneven-aged method where individual trees of all size classes are removed more or less uniformly throughout the stand, to promote growth of remaining trees and to provide space for regeneration.

Skidding

Moving logs by sliding from stump to a collecting point.

Slash

Woody material left after logging, pruning, thinning, brush cutting, or other management activities and/or accumulating there as a result of storm, fire, or other damage.

Slope

The amount or degree of deviation from the horizontal or vertical.

Slope stability

The resistance of any inclined surface, as the wall of an open pit or cut, to failure by sliding or collapsing.

Snag

A standing, dead tree.

Social sustainability

The capability of society to support the network of relationships, traditions, culture, and activities that connects people to the land and to one another and supports vibrant communities.

Soft snag

A snag composed primarily of softwood in advanced stages of decay and deterioration, particularly in the sapwood portions.

Softwood

A conventional term for timber and trees belonging to the evergreen group, such as pine, spruce, and fir.

Soil compaction

A physical change in soil properties that results in a decrease in porosity and an increase in soil-bulk density and strength.

Soil productivity

The capacity of a soil to support the growth of specified plants, plant communities, or a sequence of plant communities. Soil productivity may be expressed in terms of volume or weight/unit, area/year, percentage of plant cover, or other measures of biomass accumulation.

Soil survey

The systematic examination, description, classification, and mapping of soils in an area.

Spatial

Referring to the distance, interval, or area between or within things.

Special area

Area designated by law (by Congress) or statute or through administrative process (by the Secretary of Agriculture or a Forest Service official).

Special interest area

A type of management area designated by the forest supervisor for scenic, geologic, botanic, zoologic, paleontological, archaeological, historic, scenic, or recreational values, or combinations of these values. A special interest area is a type of special area designated through administrative process. Special interest areas are addressed in Forest Service Manuals 2360 and 2372.

Special use authorization or permit

A permit, term permit, lease, or easement that allows occupancy, use, rights, or privileges of National Forest System land.

Species

Organisms that successfully reproduce among themselves and cannot reproduce successfully with other organisms.

Stand

A community of trees or other vegetation sufficiently uniform in composition, constitution, age, spatial arrangement, or condition to be distinguishable from adjacent communities that form a silvicultural or management entity.

Standards and guidelines (S&Gs)

Principles specifying conditions or levels of environmental quality to be achieved.

Standard – a mandatory constraint on project and activity decisionmaking, 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))

Standards are required criteria for the design of projects and activities. Design criteria are the technical design details to ensure that projects and activities maintain or move toward the desired conditions, or at least to ensure that projects and activities do not preclude their maintenance or attainment. Design criteria provide the sideboards (i.e., define the limits) for projects and activities. Examples of other sources of constraints on the design of projects and activities include congressional direction, oil and gas leasing stipulations, regulations, timber sale contract clauses, and special use authorization standard clauses. In addition, the responsible official may develop project-specific design criteria to constrain a project. A standard differs from a guideline in that a standard is strict design criterion, allowing no variation, whereas a guideline allows variation if the result would be equally effective.

Guideline – a constraint on project and activity decisionmaking that allows for departure from its terms, so long as the purpose of the guideline is met. Guidelines are established to help achieve or maintain a desired condition or conditions, to avoid or mitigate undesirable effects, or to meet applicable legal requirements. (36 CFR 219.7(e)(1) (iv))

Guidelines are similar to standards in that they are design criteria for projects and activities to help achieve the desired conditions and objectives, or at least to ensure that projects or activities do not foreclose their maintenance or attainment. Guidelines differ from standards in that they provide flexibility for compliance, while standards are concrete limitations.

Stewardship

Caring for the land and associated resources and passing healthy ecosystems to future generations.

Stipulation

A provision that modifies standard lease rights and is attached to and made a part of the lease.

Stocking

Live trees per acre needed to meet resource objectives as identified in the forest plan or through other management decisions.

Structural diversity

Variety in a forest stand that results from layering or tiering of the canopy; an increase in layering that leads to an increase in structural diversity.

Structural stage

Any of several developmental stages of tree stands described in terms of tree age or size and density. In general, the habitat structural stages developed by the Forest Service Rocky Mountain Region staff are used. This classification has different structural stages based on tree size (diameter at breast height) and tree canopy cover percent.

Structure

The horizontal and vertical physical elements of forests and grasslands and the spatial interrelationships of ecosystems.

Stubble

The basal portion of plants remaining after the top portion has been harvested. Also, the portion of the plants, principally grasses, remaining after grazing is completed.

Substrate

The rock material varying in size from boulders to silt that is found in the bed of rivers and streams.

Succession

The sequential process of long-term plant community change and development that occurs following a disturbance.

Successional stage (seral stage)

The relatively transitory communities that replace one another during development to potential natural community.

Suitability for grazing

The appropriateness of applying certain resource management practices to a particular area of land, as determined by an analysis of economic and environmental consequences, and the alternative uses forfeited. A unit of land may be suitable for a variety of individual or combined management practices. Suitability is a determination of the appropriateness of grazing on the capable lands based on economic and environmental consequences and consideration of alternative uses forfeited if grazing is allowed.

Suitability for timber production

Lands that may be suited for timber production is a preliminary classification in the process of determining lands that are suited for timber production. This preliminary classification excludes National Forest System lands that are not suitable for timber production based on legal or technical reasons, such as lands where State, Executive order, or regulation prohibits timber production; lands that have been withdrawn from timber production; lands where timber harvest cannot be done without causing irreversible damage to soil, slope, or other watershed conditions; lands where there is no reasonable assurance of adequate restocking; and land that is not forest land.

Suitable timber base

Lands within the National Forest System that are capable, available, and suitable for timber production.

Suppression

The work of extinguishing a fire or confining fire spread.

Surface water

Water on the surface of the earth.

Sustainability

The capability to meet the needs of the present generation without compromising the ability of future generations to meet their needs.

Sustainable recreation

The 2012 Forest Planning Rule defines sustainable recreation as a set of recreation settings and opportunities on the National Forest System that is ecologically, economically, and socially sustainable for present and future generations. The Rio Grande National Forest's sustainable recreation vision means facilitating access to enduring recreational opportunities across a variety of settings on the Forest that: (1) meet both the persisting and changing needs of the public, (2) support the Forest's ecological health, (3) promote high-quality visitor experiences, (4) strengthen individuals' connection to the outdoors and sense of stewardship, and (5) are backed by innovative funding and effective partnerships.

Sustained yield

The amount of renewable resources that can be produced continuously at a given intensity of management.

"Sustained yield of the several products and services" means the achievement and maintenance in perpetuity of a high-level annual or regular periodic output of the various renewable resources of the national forests without impairment of the productivity of the land. (36 CFR 219.3)

Sustained yield limit

The amount of timber, meeting applicable utilization standards that can be removed from a forest annually in perpetuity on a sustained yield basis. It is the volume that could be produced in perpetuity on lands that may be suitable for timber production. Calculation of the limit includes volume from lands that may be deemed not suitable for timber production after further analysis during the planning process. The calculation of sustained yield limit is not limited by land management plan desired condition, other plan components, or the planning unit's fiscal capability and organizational capacity. The sustained yield limit is not a target but is a limitation on harvest, except when the plan allows for a departure.

T

Tailings

The parts or part of any incoherent or fluid material separated as refuse or separately treated as inferior in quality or value. The sand, gravel, and cobbles that pass through the sluices in hydraulic mining were formerly designated as tailings, but of late they have been called mining debris or simply debris. Tailings are distinct from overburden, which is the waste rock or other material that overlies an ore or mineral body and is displaced during mining without being processed.

Talus

The loose accumulation of fragmented rock material on slopes, especially at the base of a cliff.

Temporary road

A road necessary for emergency operations or authorized by contract, permit, lease, or other written authorization. Temporary roads are not included in a national forest's transportation atlas.

Terrestrial ecosystem

A plant community that is not dependent on a perpetual source of water to grow.

Thinning

Intermediate treatment to reduce stand density or stocking levels to meet a variety of management objectives including increasing tree growth or vigor, improving stand health or species composition, reducing fuels, or improving wildlife habitat.

Threatened and endangered species

An endangered species is a plant or animal species listed under the Endangered Species Act that is in danger of extinction throughout all or a significant portion of its range. A threatened species is any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

Threshold

The point or level of activity beyond which an undesirable set of responses begins to take place within a given resource system.

Tiering

Covering general matters in broad environmental impact statements with subsequent, narrow statements, or environmental analyses incorporating by reference the general discussions and concentrating solely on the issues specific to the statement prepared.

Timber classification

Forested land is classified under each of the land management alternatives according to how it relates to the management of the timber resource. The following are definitions of timber classifications:

Nonforested – Land that has never supported forests and land formerly forested where use for timber production is precluded by development or other uses.

Forested – Land at least 10-percent stocked (based on crown cover) by forest trees of any size, or formerly having had such tree cover and not currently developed for nonforest use.

Suitable – Land to be managed for timber production on a regulated basis.

Unsuitable – Forest land withdrawn from timber use by statute or administrative regulation (for example, wilderness), or identified as inappropriate for timber production in the forest planning process.

Timber harvest

The removal of trees for wood fiber utilization and other multiple-use purposes.

Timber production

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.

Managing land to provide commercial timber products on a regulated basis with planned, scheduled entries.

Timber sale

Selling of forest products with monetary value to meet forest plan objectives, including providing raw material for both commercial manufacturing and personal use.

Trail

A route 50 inches or less in width, or a route greater than 50 inches wide that is identified and managed as a trail.

Traditional cultural property

A property affiliated with traditional religious and cultural importance to a distinct cultural group, such as an American Indian tribe or Native Hawaiian group, that is eligible for the National Register of Historic Places because of its association with cultural practices or beliefs of a living community that (a) are rooted in that community's history, and (b) are important in maintaining the continuing cultural identity of the community. Traditional cultural properties include built or natural locations, areas, or features considered sacred or culturally significant by a group or people. While traditional cultural properties are closely associated with Native American cultures, a site need not be associated with a Native American cultural group to qualify as a traditional cultural property for the purposes of the National Register of Historic Places.

Travel management

Providing for safe, environmentally responsible, and customer-responsive movement of vehicles and people to and through public lands.

Turbidity

The measure of relative clarity of a liquid.

U

Unauthorized road or trail

A road or trail that is not a forest road or trail or a temporary road or trail and is not included in a forest transportation atlas.

Understory

That portion of a plant community growing underneath the taller plants on the site.

Uneven-aged management

The application of a combination of actions needed to simultaneously maintain continuous high-forest cover, recurring regeneration of desirable species, and orderly growth and development of trees through a range of diameter or age classes to provide a sustained yield of forest products. Cutting is typically regulated by specifying the number or proportion of trees of particular sizes to retain within each area, thereby maintaining a planned distribution of size classes. Cutting methods that develop and maintain uneven-aged stands are single-tree and group selection. (36 CFR 219.3)

Ungulate

A hoofed animal.

Unplanned ignition

The initiation of a wildland fire by lightning, volcanoes, or unauthorized or accidental human-caused fire (see wildfire).

Use of wildland fire

Management of either wildfire or prescribed fire to meet resource objectives specified in land and resource management plans.

V

Values to be protected

Include property, structures, physical improvements, natural and cultural resources, community infrastructure, and economic, environmental, and social values.

Vegetation management

Activities designed primarily to promote the health of forest vegetation in order to achieve desired results. When vegetation is actively managed, it is manipulated or changed by humans to produce desired results. Where active management of vegetation is required, techniques are based on the latest scientific research and mimic natural processes as closely as possible. Vegetation management is the practice of manipulating the species mix, age, fuel load, and/or distribution of wildland plant communities within a prescribed or designated management area in order to achieve desired results.

Viable population

A population of plants or animals large enough and distributed in such a way as to ensure its continued existence, despite all the hazards to survival such as illness, predators, old age, etc. throughout its existing range within the planning area.

Viewshed

The visible portion of the landscape seen from viewpoints. Viewpoints can include residences, recreational facilities, and travelways.

Viga

One of the heavy rafters or beams that supports the roof in American Indian architecture in the Southwest. Numerous latillas (sticks or small branches) are laid across the main vigas to form a ceiling.

W

Water right

A property right granted by a State for the use of a portion of the public's surface water resource obtained under applicable legal procedures.

Watershed

An area of land with a characteristic drainage network that contributes surface or ground water to the flow at that point; a drainage basin or a major subdivision of a drainage basin.

Water yield

The measured output of surface water, typically measured in acre-feet.

Wetlands

Those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support and that, under normal circumstances, do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas." (40 CFR 122. 2)

Wickiup

A hut used by the nomadic Indians of the arid regions of the Western and Southwestern United States, typically constructed with an oval base and a rough frame covered with reed mats, grass, or brushwood.

Wild, Scenic, and Recreational Rivers

A river or section of a river designated under the 1968 Wild and Scenic Rivers Act as wild, scenic, or recreational. Rivers may be designated by Congress or, if certain requirements are met, the Secretaries of Interior or Agriculture, as appropriate. Once designated under the Act, rivers receive special management direction that ensures the maintenance of the free-flowing nature and the outstanding natural, cultural, and recreational values of the river segment. Under the Act, river segments are required to be 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 waters unpolluted. These represent vestiges of primitive America.

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.

Wilderness

All lands included in the National Wilderness Preservation System by public law; generally defined as undeveloped Federal land retaining its primeval character and influence without permanent improvements or human habitation.

Wildfire

An unplanned, unwanted wildland fire, including unauthorized human-caused fires, escaped prescribed fires, and all other wildland fires where the objective is to put the fire out; any wildland fire not designated and managed as a prescribed fire within an approved prescription. All wildfires will receive appropriate suppression action.

Wildland fire

A general term describing any nonstructural fire that occurs in the wildland. Wildland fires are categorized into two distinct types:

Wildfires – Unplanned ignitions or prescribed fires that are declared wildfires

Prescribed fires – Planned ignitions.

Wildland-urban interface

The line, area, or zone where structures and other human developments meet or intermingle with undeveloped wildland or vegetation fuels.

Windthrow

The act of trees being uprooted by the wind.

Winter range

An area used by deer and elk during the winter months; generally at lower elevations and/or south and west exposures.

Withdrawal

An action that restricts the use of public land and segregates the land from the operation of some or all of the public land and mineral laws. Withdrawals are also used to transfer jurisdiction of management of public lands to other Federal agencies.

Appendices

Appendix A: Wilderness Analysis Process

Introduction and Process

When developing or revising a forest plan, the Forest Service must identify and evaluate lands that may be suitable for inclusion in the National Wilderness Preservation System and determine whether to recommend any of these lands to be designated as wilderness. This process involves four steps; inventory, evaluation, analysis and recommendation. The inventory and evaluation steps were completed prior to beginning the analysis. The steps were documented in separate documents found on the Rio Grande website; the inventory process is shown on the Final Wilderness Inventory and Draft Evaluation map, and the evaluation determination is contained in the Rio Grande National Forest Draft Wilderness Evaluations (USDA Forest Service 2016).

Forest Service directives for forest plan development or revision contain a framework for the wilderness recommendation process at Forest Service Handbook 1909.12, Chapter 70.

The wilderness inventory resulted in 92 numbered polygons, or over 1.5 million acres that met the criteria defined for the inventory process. All wilderness inventory areas went through the wilderness evaluation. The numbered polygons were evaluated for five wilderness characteristics and grouped into six categories: low, low-moderate, moderate, moderate-high, high, and high-upper tier. The five wilderness characteristic defined in Chapter 70 include: apparent naturalness; opportunities for solitude or unconfined recreation; size; ecological, scientific, educational, scenic, or historical values; and manageability. For the most part all numbered polygons that were ranked as moderate-high, high, or high-upper tier are considered in this analysis. Some areas boundaries were modified based on on-the-ground conditions and public comment received in response to the inventory and evaluation processes and scoping of the proposed action.

The areas listed below are brought forward into analysis in alternatives B and D for recommended inclusion in the wilderness system. During the analysis, the numbered polygons are further described relative to geography and status under the Colorado Roadless Rule.

The descriptions of the areas are below. The final areas are a product of the inventory and evaluation process and public comment during the inventory and evaluation process, as well as review of comments received from public scoping.

The areas carried forward into analysis are mapped. However, if an area were selected for further recommendation for inclusion into the National Wilderness Preservation System, more work would be needed. For example boundaries would need to be better defined, topography, vegetation and unique features would be further evaluated.

Analysis

In addition to the analysis of recommended wilderness in the environmental impacts states, the Forest Service Handbook 1909.12, Chapter 70 require that for all areas recommend for wilderness the following items must be addressed:

- The name of the area and number of acres to be considered;
- The location and a summarized description of a recommended boundary for each area;
- A brief description of the general geography, topography, and vegetation of the recommended area;
- A brief description of the current uses and management of the area;

- A description of the area's wilderness characteristics and the ability to protect and manage the area to preserve its wilderness characteristics;
- A brief summary of the factors considered and the process used to evaluate the area and developing the alternatives;
- A brief summary of the ecological and social characteristics that would provide the basis for the area's suitability for inclusion in the National Wilderness preservation System.

Alternatives A and C

Alternative A, the no-action alternative, is based on the existing forest plan which has been in place since 1996. Alternatives A and C do not recommend any additional acres for inclusion the National Wilderness Preservation System. This is further described in the environmental impact statement.

Alternatives B and D

Based on the results of the wilderness evaluation an estimated 58,669 acres of wilderness is recommended in Alternative B. Many of the acres are designated under the Colorado Roadless Rule so the areas already have characteristics related to naturalness, less development, opportunities for solitude, and other features. Alternative D, emphasizes a more natural experience and proposes over 280,000 acre of recommended wilderness. As in Alternative B many of the area correspond with areas designated under the Colorado Roadless Rule. Further analysis can be found in the *Recommended Wilderness* section of the environmental impact statement. All acreages are approximate and are based on data from the geographic information systems.

Areas only in Alternative D

Antora Meadows/Bear Creek (Polygon 6) - 21,480 acres

Boundary Description

The northern border is the Continental Divide National Scenic Trail abutting the Gunnison National Forest and the northwest boundary is abuts the Pike and San Isabel National Forests. The southern boundary is primarily Bureau of Land Management and private lands and National Forest System Road 880.2B. A cherry stemmed mining claim occurs on the west side. The western boundary follows the boundary for the upper tier Antora Meadows Colorado Roadless Area. The eastern boundary approximately by National Forest System Road 861 in the Slaughterhouse Creek watershed. The area's eastern boundary, north of Mosquito Lake, is abuts the Pike-San Isabel National Forest. There is an estimated 2,066 acres that coincides with Management Area 4.23. If recommended for inclusion in the Wilderness Preservation System this 2,066 acres would most likely be managed for both wilderness and congressionally designated trail values.

The area being analyzed was reduced to match but not overlap the Congressionally Designated Management Area and to make it correspond with roadless area boundaries.

Geology, Topography, and Vegetation

The area is characterized by drainages running through steep narrow canyons with some mountain parks. The area almost completely encompasses the Antora Meadows-Bear Creek Colorado Roadless Area with elevations ranging from 7,545 to 13,296 feet (Antora Peak). This area is adjacent to the Starvation Creek roadless area on the Pike-San Isabel National Forest.

Vegetation consists of bunchgrass/ponderosa pine in lower elevations, some lodgepole pine with large stands of aspen in mid-elevations, and spruce/fir at high elevations. There is some subalpine and alpine vegetation along the Continental Divide.

Antora Meadows lies in the Saguache Creek watershed north of Saguache.

Current Uses and Management

The area is administered by the Saguache Ranger District.

The area almost completely encompasses the Antora Meadows-Bear Creek Colorado Roadless Area with elevations ranging from 7,545 to 13,296 feet (Antora Peak). This area is adjacent to the Starvation Creek roadless area on the Pike-San Isabel National Forest.

Ability to Protect Wilderness Characteristics

A permitted natural gas line running through the center of the area. Primary access to the area is from National Forest System Roads 870 and 880. National Forest System Road 578 provides access to a portion of motorized Continental Divide Trail from which the Antora Meadows/Bear Creek area can also be accessed

With the exception of historical timber harvest, this area is relatively natural in appearance and has long term, intact and functioning ecological processes.

The lack of large bodies of water, dry environment, and large expanse of roadless landscape provide solitude throughout the area. This remoteness allows visitors to achieve solitude in any of the tributary valleys.

The 20 miles of non-motorized trails in many cases parallel lush riparian zones of willow, blue spruce and aspen that makes this a destination for horseback riding, hiking and wildlife viewing. The Middle Creek trailhead is popular with backcountry horse users, and the trails are signed as closed to mountain bikes.

This area is currently managed for backcountry and roadless characteristics, which both emphasize a more primitive experience.

Patented mining claims at Antora Meadows are cherry-stemmed out of the unit boundary along with the access route via FDR 880.2B. A short, dead-end and motorized trail (764) extends two miles north of Antora Meadows. There are no oil and gas leases within the boundaries.

Factors Considered and Process Used in the Evaluation

Introduced pure Rio Grande cutthroat trout occupy the upper reaches of East Middle Creek. Area streams, include West Middle Creek, the main stem of Middle Creek, and Indian Creek, all of which support sport fisheries of brook and brown trout in a network of beaver ponds. The East Middle Creek area is a Colorado Natural Heritage Program Potential Conservation Area of moderate biodiversity significance due to the trout population.

Ecological and Social Characteristics that Would Provide a Basis for Suitability for Inclusion in the National Wilderness Preservation System

The area hosts an array of habitats from sagebrush to alpine tundra, and provides habitat or potential habitat for the federally listed Canada lynx (threatened) and the Mexican spotted owl. Although a low-use area for lynx, it borders the Poncha Pass Lynx Linkage area and lynx have been known to pass through. The area also provides habitat for American marten, bighorn sheep and goshawk.

Additionally, Blue grouse have been documented and the area provides deer and elk winter habitat as well as refuge for deer and elk from adjacent hunting pressure.

Antora Meadows is one of the few areas in Colorado where all of the state's major forest types coexist. Antora Meadows contains ecosystems considered under-represented among existing wilderness areas on the Forest. There is an abundance of conifer species here not generally found in close proximity, including Colorado blue spruce, Douglas fir, Engelmann spruce, lodgepole pine, limber pine, ponderosa pine, subalpine fir, and white fir. This is one of the only areas where lodgepole pine naturally occurs on the Rio Grande.

Antora peak provides views of the San Luis Valley to the South, Arkansas Valley to the north, Gunnison Basin to the west and the Sangre de Cristo Wilderness to the east.

Conejos River/Lake Fork (Polygons 61) – 1,020 acres

Boundary Description

This area is located on the southwest border of the Forest in Conejos County and encompasses the Conejos River/Lake Fork Colorado Roadless Area. It is bounded by the South San Juan Wilderness to the west, private property to the south and the Conejos River to the north and east (USDA Forest Service 1982).

Geology, Topography, and Vegetation

The area is characterized as a long, narrow, and steep-sided canyon with the Conejos River traversing its entire length. The steep-sided canyons have stands of Engelmann spruce and alpine fir interspersed with aspen stands and meadows. Riparian and cottonwood are found by the river.

Current Uses and Management

General access to this area is from National Forest System Road 250 (Conejos River Road) which parallels the eastern boundary. Steep hillsides on either side of the Conejos River drainage limit access to the Colorado Roadless Area

Ability to Protect Wilderness Characteristics

The majority of the area appears natural though grazing activities, evidence of historical mining and timber harvest are present.

Opportunities for Solitude or Primitive and unconfined recreation are found throughout the area due to steep and rugged terrain and a lack of trails. Overall recreation use is minimal and a feeling of remoteness and seclusion can be experienced. Some uses may impact solitude including authorized motorized access, grazing improvements and the proximity of National Forest System Road 250.

The area can be managed to preserve wilderness character. The boundary is adjacent to the South San Juan Wilderness and falls within a designated Colorado Roadless Area. The area includes no non-federal inholdings and there are no oil and gas leases.

Factors Considered and Process Used in the Evaluation

This area provides habitat for the federally listed Canada lynx (threatened) and their presence in the area has been documented. The steep north-facing slopes and drainages are potential reproduction and hunting sites.

The area also provides potential habitat for bighorn sheep, American marten and goshawk. Other notable species include black bear, mule deer, and elk. Steep north-facing hillsides provide areas of cover and forage for elk; the area is migratory hunting grounds for peregrine falcon. There are peregrine falcon nests on adjacent cliffs to the east.

Approximately 870 acres of the Colorado Roadless are in the area, as well as river segments determined as eligible Recreation Rivers under the Wild and Scenic Rivers Act.

Ecological and Social Characteristics that Would Provide a Basis for Suitability for Inclusion in the National Wilderness Preservation System

The location of this polygon and the configuration of the land base result in very little use.

The area contains habitat for wildlife along a well-used road.

Bristol Head (Polygons 26) – 39,330 acres

Boundary Description

This area is located west of Creede, Colorado in Mineral and Hinsdale Counties and is administered by the Divide Ranger District. The northern boundary is the Congressionally Designated Management Area that is concurrent with the Continental Divide National Scenic Trial and a portion of the La Garita Wilderness administered by the Grand Mesa, Uncompahgre, and Gunnison National Forests. The southern and eastern boundaries align with the designated Bristol Head Colorado Roadless Area, with the exception of a small section of upper tier roadless that peninsulas to the southwest. The western border is Highway 149 to where it connects with the western boundary of the Bristol Head Colorado Roadless Area. An estimated 3,608 acres of the areas coincides with Management Area 4.23. If the responsible official chooses to recommend this area for wilderness designation, the coincidental acres would most likely be managed for both wilderness and congressionally designated trail values.

Geology, Topography, and Vegetation

Landforms found in the area include mountains and valley plains. This area is characterized by gentle alpine slopes from Bristol Head and Table Mountain to Snow Mesa, steep cliffs below and south of Bristol Head, gentle to moderate mountain slopes with flood plain, toe slopes and fans in canyons and valley bottoms.

Current Uses and Management

The majority of the Bristol Head Colorado Roadless Area, including the upper tier roadless, is encompasses by the area.

This area is currently managed under the Management 3.3 (Back Country Management Area) and the Colorado Roadless Area Rule which both emphasize a more primitive and roadless character.

With the adjacent border of the La Garita Wilderness, this area would extend the wilderness (excluding the Continental Divide Trail Management Area). There would, however, be management issues initially due to current management of motorized trails and snow mobile use.

This area is currently managed under the Management 3.3 (Back Country Management Area) and the Colorado Roadless Area Rule which both emphasize a more primitive and roadless character.

The area is accessed from Highway 149 along the upper western boundary, National Forest System Road 532 near the mid-western boundary, National Forest System Roads 509 (Santa Maria) and 508

(Shallow Creek) at the southeast boundary, National Forest System Road 507 (Miner Creek) at the eastern boundary, and National Forest System Road 505 (Rat Creek) at the northeast boundary.

Ability to Protect Wilderness Characteristics

The area in upper tier roadless is relatively natural in appearance although there is evidence of historical mining, timber harvest and the Miners Creek motorized trail.

Areas outside the upper tier roadless have a lesser degree of naturalness as signs of current and past management are more evident. Grazing occurs in the area and range improvements include fencing and water developments. Motorized access is allowed for range improvements. Private in-holdings occur and a communication site adjacent to the area could impacts apparent naturalness.

Forest visitors can get a sense of remoteness and seclusion in the area. Approximately 18 miles of motorized trails and 22 miles of nonmotorized trails are found in the area. There is also a connector trail to the and Colorado Trail as well as groomed snowmobile trail that follows the Continental Divide National Scenic Trail.

Factors Considered and Process Used in the Evaluation

The area has a bighorn sheep population, critical habitat for the Uncompahgre fritillary butterfly, denning and potential habitat for Canada Lynx.

Important cultural sites can be also found throughout the area.

Proximity to the Continental Divide National Scenic Trail and incredible high elevation vistas.

Ecological and Social Characteristics that Would Provide a Basis for Suitability for Inclusion in the National Wilderness Preservation System

The area provides habitat and denning habitat for the federally listed Canada lynx and also for American marten, and bighorn sheep. The Seepage Creek drainage and cliffs east of Santa Maria Reservoir are a summer concentration area for bighorn sheep.

Northern goshawk has been documented in this Colorado Roadless Area.

The area provides elk and mule deer summer range and production areas, and the south and east portions are winter concentration areas.

The area also provides moose habitat and is adjacent to priority habitat area for moose in North and South Clear Creeks.

An active bald eagle nesting site is adjacent to the boundary.

Elkhorn Peak (Polygon 4) – 15,180 acres

Boundary Description

This area located in Saguache County is administered by the Saguache Ranger District. The area is defined by the Forest boundary to the south, west and east. To the east and west the area is bordered by private and Bureau of Land Management lands. To the west is the town of Bonanza and the Bonanza Historic Mining District. The northern boundary generally consists of forest roads and patented mining claims.

Geology, Topography, and Vegetation

The area encompasses the high points of Elkhorn (12,027 feet) and Hayden Peak (12,130 feet) and several of the drainages radiating from these peaks.

The elevational gradient creates a continuum of ecosystems through large stands of aspen to lodgepole pine and extensive forests of Engelmann spruce and subalpine fir. Bristlecone pine and limber pine can be found on windblown dry rocky ridges and slopes. National Forest System Road 56 (Peterson Creek road) borders the eastern portions of the area and National Forest System Road 873 (Kelly Cr. Road) is in the area, but is closed above the Forest boundary. This area has several National Forest System trails.

Plant communities appear relatively natural with representations of ponderosa pine in the lower elevations, Douglas-fir in mid-elevations, and alpine associations at higher elevations. Aspen stands occur in areas burned in the past.

The lowest slopes consist of rolling grasslands and ponderosa pine woodland at the national forest boundary with adjacent federal lands, while forests of lodgepole pine and Douglas fir blanket the higher slopes.

Current Uses and Management

The area encompasses the Elkhorn Peak Colorado Roadless Area including upper tier roadless and is managed for backcountry values.

Elkhorn Peak is currently managed to retain its roadless characteristics throughout the Colorado Roadless Area. The area is a compact shape with readily identifiable topographic boundaries. There are no oil and gas leases.

Ability to Protect Wilderness Characteristics

There are signs of historical mining, timber harvest and motorized roads occurring in the southwest area that represent a departure from apparent naturalness.

Livestock grazing occurs and range improvements include fencing and water improvement occur in the area.

Opportunities for solitude and ample vistas are commonplace when exploring Elkhorn Peak. The feeling of seclusion and remoteness is particularly enhanced in the area’s western portion, amidst the rugged Elkhorn and Hayden peaks.

There are several non-motorized trails that access the area and outfitter and guide activities occur during the fall, but use is not high and generally would not impact opportunities for solitude or primitive and unconfined recreation overall.

Factors Considered and Process Used in the Evaluation

Approximately 2 miles of Kerber Creek which is listed as state 303(d) impaired waters.

The area provides habitat for the federally listed Canada lynx (threatened). Potential for lynx occurrence in the area, however, is low. The area also provides potential habitat for American marten and wolverine, both Forest Service sensitive species, as well as valuable deer and elk winter range. Elkhorn Gulch and Kelly Creek contain networks of beaver ponds and support brook trout fisheries.

The Colorado Natural Heritage Program, 2,014 acres Kelly Creek which is ranked for High Biodiversity Significance is in the area. The Kelly Creek Potential Conservation Area includes a wetland complex with montane riparian shrubland. Beaver ponds expand the floodplain habitat, helping to maintain the healthy ecosystem.

Elkhorn Peak contains several ecosystems under represented among existing wilderness areas on the Forest.

Ecological and Social Characteristics that Would Provide a Basis for Suitability for Inclusion in the National Wilderness Preservation System

There are signs of historical mining, timber harvest and motorized roads occurring in the southwest area that represent a departure from apparent naturalness.

The area has long term, intact, and functioning ecological processes.

A feeling of seclusion and remoteness can be experienced as well as a high degree of self-reliance, challenge and risk.

North Fork/ Rock Creek (Bennett Mountain/Blowout/Willow Creek/Lion Point/Greenie Mountain) (Polygons 51) – 17,140 acres

Boundary Description

The Forest boundary forms eastern boundary of the area. The western boundary is Forest lands along with the West Fork of the San Francisco River with the West Frisco motorized trail as the boundary. The northern boundary starts around the Middle Frisco Trailhead and extends southeast to border private lands intermixed with Forest Service lands along Pinos Creek. The southern boundary follows County Road 28, which includes Forest Service and private land.

Geology, Topography, and Vegetation

Elevations range from a low of 8,880 to 12,840 feet at the peak of Pintada Mountain.

The lower elevation terrain consists of pinyon-juniper and ponderosa pine stands with mid elevations consisting of Douglas-fir and aspen stands and high elevation consisting of Engelmann spruce and fir stands interspersed with aspen.

Current Uses and Management

The areas is located just southwest of Del Norte, Colorado in Rio Grande County and is administered by the Divide Ranger District. The area contains a large portion the Bennet Mountain/Blowout/Willow Creek/Lion Point/Greenie Mountain Colorado Roadless Area, which is designated as both upper tier and roadless. Adjacent lands are primarily managed by the Bureau of Land Management and intermixed with private lands.

The West Frisco motorized trail provides access along the boundary and Middle Frisco trail provides non-motorized trail access in the northwest portion of the area and direct access to the San Francisco Lakes. North Rock and Dry Creek trails provide access to the central portion of the area.

The area is traversed by two non-motorized trails, the North Rock Trail 701 and the Dry Creek Trail 700. Each trail offer a half-dozen miles of exploration for hikers, anglers and equestrians. One trail parallels the creek and crosses back and forth multiple times, while the other trail navigates the high slopes above treeline and meanders down through a range of forest transitions.

Ability to Protect Wilderness Characteristics

Visitors can readily experience outstanding opportunities for solitude. The high points above timberline on Windy Mountain and Pintada Mountain offer outstanding vistas and impart a sense of isolation amidst a large, undeveloped landscape.

Management challenges may occur along the northern boundary where the areas joins with private lands.

Factors Considered and Process Used in the Evaluation

The area is part of the Bennet Mountain/Blowout/Willow Creek/Lion Point/Greenie Mountain Colorado Roadless Area, which displays a substantial level of naturalness throughout the area. The area provides important winter range for deer and elk, which translates also into opportunities for backcountry hunting.

This area would increase the ecological representation on the Rio Grande for Southern Rocky Mountain Montane-Subalpine Grassland, Southern Rocky Mountain Ponderosa Pine Woodland, Rocky Mountain Pinyon-Juniper Woodland, and Southern Rocky Mountain Mesic Montane Mixed-Conifer Forest and Woodland.

The North Fork of Rock Creek watershed provides an isolated setting shielded from the San Luis Valley with views of the valley from mountain peaks.

Ecological and Social Characteristics that Would Provide a Basis for Suitability for Inclusion in the National Wilderness Preservation System

There are several major drainages in the area.

This area contains some of the oldest Bristle-Cone Pine trees on the Forest.

This area has high elevation mountain lakes including San Francisco Lakes.

High elevations offer outstanding vistas and impart a sense of isolation amidst a large, undeveloped landscape.

Pole Mountain/Finger Mesa (Polygon 28) – 31,260 acres

Boundary Description

This area is found in the western portion of the Forest in San Juan and Hinsdale Counties, as is managed by the Divide Ranger District.

The area lies along the Forest boundary adjacent to the Congressional Designated Trail Management Area for the Continental Divide National Scenic Trail. An estimated 3,690 acres of the areas coincides with Management Area 4.23, if the area were recommended this area would most likely be managed for both wilderness and congressionally designated trail values. The boundary for the San Juan National Forest is to the Northwest, with Bureau of Land Management lands to the North and the Gunnison National Forest to the Northeast.

Geology, Topography, and Vegetation

The area is located in the headwaters area of upper Rio Grande.

This area is characterized by alpine slopes, to very steep alpine ridges, talus slopes, and glacial basins, gentle to steep mountain slopes to floodplain, toe slopes and fans in canyon and valley bottom.

Current Uses and Management

Access is by National Forest System Road 520 (Rio Grande road) which is along the southern boundary, National Forest System Road 533 (Sawmill Canyon finger Mesa) on the southeast boundary, National Forest System Road 516 (Mason Creek) on the eastern boundary, and National Forest System Road 518 (Heart Lake) on the northeast boundary.

Portions of several grazing allotments occur in the area and will have improvement such as fences and water improvements.

Ability to Protect Wilderness Characteristics

As the designated Pole Mountain–Finger Mesa Colorado Roadless Area, the management emphasis is protection of roadless characteristics.

There are approximately 28 miles of motorized trails in the area. However, due to the area’s size and rough terrain, one can get a sense of remoteness and seclusion, especially in the area away from the motorized trails.

No oil and gas leases occur in the area.

To protect wilderness character a closure of approximately 28 miles of motorized trails would be required. These areas have compact boundaries and are situated in perhaps the most remote location of the Forest, at the very headwaters of the Rio Grande.

Factors Considered and Process Used in the Evaluation

The area provides habitat and has documented colonies of the federally listed (endangered) Uncompahgre fritillary butterfly at higher elevations. The area receives high-use by Canada lynx and is a key area to lynx movement between the Rio Grande and San Juan National Forests. The area also provides denning habitat for this federally listed species. A lynx den site has been documented near the area.

Additionally, the area provides potential habitat for the southwest willow flycatcher (endangered) and habitat for bighorn sheep and American marten. Elk and mule deer summer concentration habitat, elk production habitat, and bighorn sheep summer, winter and production habitat are all found in the area.

Lost Trail Creek provides priority habitat for moose. Other species known to be present include black bear, beaver, and ptarmigan. Peregrine falcons forage in the area and there is high quality potential nest habitat available.

The area is important for several species of conservation concern. This area is also the only known global occurrences of the stonecrop gilia.

This area includes the existing Finger Mesa Research Natural Area, designated in 1996 for unique geologic and botanical features which are an isolated erosional remnant of a tertiary volcanic plateau.

It also includes portions of two Colorado Natural Heritage Program Potential Conservation Areas. Two globally vulnerable riparian plant communities, Booth's willow/mesic forbs shrubland and Wolf's willow/mesic forbs shrubland, occur within a large subalpine willow carr along the upper reaches of the Pole Creek Potential Conservation Area and are ranked as High Biodiversity Significance. The Sheep Mountain portion includes the entirety of the Sheep Mountain in San Juan Potential Conservation Area, which is ranked as Very High Biodiversity Significance.

Off of West Lost Creek Trail, there is a natural scenic landslide that created popular ponds.

Ecological and Social Characteristics that Would Provide a Basis for Suitability for Inclusion in the National Wilderness Preservation System

The area has long term, intact functioning ecological processes. It is fairly natural with the few and substantially unnoticeable evidence of historic mining, dredging and timber harvest.

Visitors can experience a sensation of vastness and isolation unparalleled on the Forest. From many vantage points, all one can see is undulating tundra ridges retreating into the distance, interrupted by soaring peaks.

Pole Creek Mountain includes over 20 miles of streams managed for recreation populations of Rio Grande cutthroat trout. Pole Creek, Lost Trail Creek, and West Lost Trail Creek create a large connected population along with adjacent streams in the headwaters of the Rio Grande below Stony Pass.

The lower slopes of Pole Creek Mountain along the Rio Grande would increase the ecological representation within Rio Grande National Forest wilderness areas of Southern Rocky Mountain Montane-Subalpine Grassland.

Saguache Park/Four Mile Creek/Taylor Canyon (Polygon 12) – 23,040 acres

Boundary Description

The Saguache Ranger District manages this part of the Forest. The area is bordered on the east by federal land managed by the Bureau of Land Management, and a few private parcels, and on the northern and western boundaries by Rio Grande. Approximately 649 acres of this area coincides with Management Area 4.23.

Geology, Topography, and Vegetation

They encompass an extremely rugged, lower-elevation area of rocky fin-shaped ridges separated by small meadows and canyons in between. The majority of these areas sit in the 9,000 to 9,500 foot elevation range, with the highest points along rims of the Saguache Creek canyon reaching above 10,600 feet.

Much of the area is covered with ponderosa pine in the lower foothills, and Engelmann spruce/subalpine fir at higher mountainous terrain. Several portions of the area have had extensive natural fires between 80-150 years ago that have shaped vegetation communities.

Current Uses and Management

The area is dissected into several distinct parts by National Forest System Roads 736 (Duckfoot Creek), 761 (Lost Spring), and 740 (Four Mile), and 776 (Saguache Creek).

The Taylor Canyon and Four Mile Creek Colorado Roadless Areas are found in the area and are unique in the Saguache District for their topography and habitat types. Being managed as backcountry and roadless emphasizes a more primitive experience.

All trails in the proposed wilderness are designated non-motorized. The inclusion of private inholdings and cherry stemmed roads may detract from manageability. There are no oil and gas leases.

Ability to Protect Wilderness Characteristics

The general landscape is relatively natural in appearance.

Opportunities for solitude and unconfined recreation are greatest in the central and eastern portions of the area. There are approximately 21 miles of non-motorized trail in the area. Grazing activities, particularly in the western portion of the area may take away from the solitude and remoteness from civilization however, grazing is not an incompatible use with wilderness designation.

Portions of Saguache Creek are managed to preserve the outstandingly remarkable features tied eligibility as Wild and Scenic River. This premier destination for trout fishing is popular recreational activity. Fly fishermen avidly cast the seven-mile length of Saguache Creek for brown and rainbow trout using flies and lures only. Hikers and backpackers enjoy the stream corridor as well, relishing the rugged grandeur of the 1,500-foot deep canyon. Hikers can find complete isolation trekking into the lower reaches of Fourmile Creek and Luders Creek amidst lush riparian zones surrounded by stately ponderosa pines along infrequently maintained trails.

Factors Considered and Process Used in the Evaluation

The area provides habitat for federally listed species such as Canada lynx (threatened), and Mexican spotted owl (threatened). The area also provides habitat for species such as bighorn sheep, American marten and goshawk. Peregrine falcons also use the area.

Saguache Creek runs through the area from west to east as a wild and scenic river proposed management area.

Unique features in the area include cultural properties and fens within the evaluation area. The proposed wilderness also provides ecological continuity from the grasslands along lower Saguache Creek extending up through to its headwaters amidst the alpine tundra of the nearby La Garita Wilderness.

Ecological and Social Characteristics that Would Provide a Basis for Suitability for Inclusion in the National Wilderness Preservation System

The area has long term, intact functioning ecological processes.

The two Colorado Roadless Areas form part of a large landscape important for maintaining the ecological health of the habitat used by many terrestrial, aquatic and avian species.

Sawlog (Polygon 15) – 16,240 acres

Boundary Description

This area is located approximately 12 miles southwest of the town of Saguache, in Saguache County and is administered by the Saguache Ranger District. Lands manages by the Bureau of Land Management, state and private lands border the area on the northeast and southern boundaries. The north and east border is national forest.

Access to the area is via Lime Creek and Bredell Creek road off of Bureaus of Land Management lands and National Forest System Road 41.G (North Carnero), Poison Gulch, Sawlog Gulch, National Forest System Road 675 (South Fork), National Forest System Road 2B (Royal Gulch via Mexican Park) and National Forest System Road 623 (Fullerton Park) from National Forest System lands.

Geology, Topography, and Vegetation

The area is characterized by gently rolling hills to steep rocky outcrops. Drainages run primarily to the south.

Vegetation is comprised of pinyon-juniper in lower elevations, ponderosa pine at mid-elevation, and spruce-fir intermingled with aspen at higher elevations. Small to large bunchgrass parks are found throughout. The Sawlog and Poison Gulch portions of the area are characterized by very large, open expanses of grasslands on the south-facing slopes and dense conifer stands on the north-facing slopes.

Current Uses and Management

Surrounding areas are managed as general forest and for rangeland vegetation. The area encompasses the upper tier and general roadless Sawlog Colorado Roadless Area and extends beyond the area to the north.

Ability to Protect Wilderness Characteristics

In general, much of the area appears relatively natural, with the exception of areas adjacent to constructed developments, inholdings, historic mining, timber harvest, and rehabilitated roads.

Opportunities for solitude or primitive and unconfined recreation can be found in the area. The area lacks a well-developed trail system, but there is a non-motorized trail along the North Fork.

The area provides important lambing habitat for the local bighorn sheep herd and elk and deer winter range along the southern aspects. This habitat provides prime habitat that draws hunters seeking a remote and challenging opportunity.

This area is currently managed for backcountry and roadless values both of which emphasize a more primitive experience.

There are no oil and gas leases. The presence and extent of other uses in and adjacent to this area could pose some challenges to maintaining wilderness characteristics.

The areas contains the Sawlog and San Juan Maez cattle and horse allotments, which include fencing and water developments.

Factors Considered and Process Used in the Evaluation

Past sheep grazing has affected forb composition.

The area provides habitat for the federally listed Canada lynx (threatened) and presence has been documented. Additionally, the area provides habitat bighorn sheep, American marten and goshawk. Bighorn sheep habitat occurs here and there is important year-round range for elk and deer. The area encompasses a large portion of the North Carnero Creek watershed and has just over 1 mile of North Carnero Creek which hosts a wild population of pure Rio Grande Cutthroat Trout and an introduced population of Rio Grande sucker.

This area provides opportunities for primitive backcountry hunting and fishing.

The proposed area includes a portion of the Colorado Natural Heritage Program Carnero Creek Potential Conservation Area. This Potential Conservation Area is ranked as High Biodiversity Significance owing to bristlecone pine woodland, a montane grassland, and a Rio Grande cutthroat trout population, all of which are state rare.

The proposed area increases the ecological representation in Forest wilderness areas of several underrepresented ecosystem types on the forest, including Southern Rocky Mountain Montane-Subalpine Grassland, Ponderosa Pine Woodland, and pinyon-juniper Woodland.

Ecological and Social Characteristics that Would Provide a Basis for Suitability for Inclusion in the National Wilderness Preservation System

The area contains approximately 3 miles of cherry-stemmed roads, one for access to a private inholding.

The area has long term, intact functioning ecological processes.

Adjacent and cherry stem roads, as well as user created roads, are present in the area.

Snowshoe Mountain (Polygon 38A) – 30,220 acres

Boundary Description

This area is located just south of Creede. Colorado in Mineral County and is administered by the Divide Ranger District. It is bordered on the south, as well as portions of the northeast and northwestern corners by Forest Service lands. A small section of the southernmost boundary is adjacent to the Weminuche Wilderness area. The remainder of adjacent land is privately owned.

Geology, Topography, and Vegetation

This area is characterized by moderate to steep forested mountain slopes, benches (open parks) known as Seven Parks and gentle rolling slopes with aspen. Part of the area drains into Goose Creek but the majority flows into Deep Creek.

The main plant association in the conifer type is subalpine fir/Engelmann spruce/Rocky Mountain whortleberry and Aspen/Thurber fescue. Plants associated with mountain valleys and openings are willow/sedge and Thurber fescue/Arizona fescue.

The mountain offers intriguing geologic interest as a resurgent dome within the Creede caldera bisected by conspicuous graben faults.

Current Uses and Management

There are only two roads in proximity of the area; National Forest System Road 523 (Middle Creek road) on the eastern boundary and National Forest System Road 528 (Lime Creek Road) bordering the southern boundary.

The area corresponds with the Snowshoe Mountain Colorado Roadless Area, which contains both upper tier and general roadless. A small piece or the northern portion is the Deep Creek Special Interest Area.

Much of the area is currently managed for motorized and non-motorized opportunities for backcountry and roadless values. There are approximately 13 miles of non-motorized trails in the area.

Ability to Protect Wilderness Characteristics

The area is natural in appearance with the exception of historic mining and timber harvest evident in isolated areas. Past mining activity is associated with the 1889 Creede silver discovery. Range improvements include fencing and water developments. There is approximately 1mile of Maintenance Level 1 (administrative use) road in the area.

Factors Considered and Process Used in the Evaluation

This is a high use area for the federally listed Canada lynx (threatened) especially in the south end with habitat and denning. Lynx have been documented in the area. The area also provides potential habitat for American marten, moose and summer and winter range and production areas for mule deer, elk.

The area provides a quality backcountry hunting experience for elk, deer and moose.

Snowshoe Mountain includes the entirety of the 417 acre Colorado Natural Heritage Program Deep Creek Uplands West Potential Conservation Area which is ranked as Very High Biodiversity Significance. This Potential Conservation Area includes one of the best known populations of Smith whitlow-grass, a Colorado endemic and globally imperiled species, as well as a population of globally imperiled black canyon gilia.

Snowshoe Mountain contributes many acres under-represented ecosystem types among existing wilderness areas on the Forest. Protecting this area, would increase the ecological representation in wilderness Southern Rocky Mountain Montane-Subalpine Grassland.

Ecological and Social Characteristics that Would Provide a Basis for Suitability for Inclusion in the National Wilderness Preservation System

The area has long term, intact functioning ecological processes.

The size of the area and the terrain offers a sense of seclusion and solitude.

Wannamaker/Lake Fork/Sheep Mountain/Deep Creek/Boot Mountain (Polygon 20A) – 18,140 acres

Boundary Description

The western and southern boundary is the La Garita Wilderness. The northern portion is the Lake Fork Colorado Roadless Area and general forest. The east side abuts Forest land.

Geology, Topography, and Vegetation

The landscape in and around the area is characterized by deep narrow canyons, steep slopes, and alpine plateaus. It is dissected by four major drainages Wannamaker, Bear, Deep, and Johns Creeks.

Boot Mountain is high, mountainous terrain with mature and pole sized Engelmann spruce/subalpine fir stands with interspersed open parks. There are inclusions of aspen, subalpine and alpine associations.

The Lake Fork Colorado Roadless Area and surrounding areas are characterized by a large plateau in the north, with drainages running primarily to the east and north. It is dissected by several drainages including Lake Fork Saguache Creek, Miners Creek, North Fork Saguache Creek, and several minor drainages. The northern area of the Lake Fork Colorado Roadless Area is gently to moderately sloping. Vegetation is mainly spruce/fir associations with aspen stands and mountains.

The Sheep Mountain Colorado Roadless Area lies along an extremely rugged ridge top. Drainages run east and west into Saguache Creek. The area is a high plateau with steep sides. Vegetation is predominately spruce/fir with aspen stringers and small parks. Sheep Mountain Colorado Roadless Area and Lake Fork Colorado Roadless Area are partially contiguous and both are adjacent to the La Garita Wilderness area in the Saguache Park area. The Sheep Mountain Colorado Roadless Area consists almost exclusively of dense subalpine timber on steep slopes.

Current Uses and Management

Three upper tier Colorado Roadless Areas are found in the area including: Lake Fork, Sheep Mountain, and Deep Creek/Boot Mountain.

Many roads provide access. In the west, National Forest System Road 744 (Middle Fork Saguache), National Forest System Road 776.1b (North Fork), and National Forest System Road 787.3c (Fish Pond); in the central portion of the area, National Forest System Road 787 (Saguache Park); and from the south, National Forest System Road 640 (Embargo Creek). Several smaller roads or sections of roads surround and create cherry stems into the area.

This area is currently managed for backcountry and roadless values which both emphasize a more primitive and roadless experience.

There are no oil and gas leases.

Ability to Protect Wilderness Characteristics

Apparent naturalness can be found to a high degree is some areas with exceptions in places where evidence of past timber harvest, mining, travel and grazing activities have occurred.

There are just over 8 miles of closed roads, a private inholding, motorized trails, fence and water developments that represent a departure from natural conditions. Evidence of past mining can also be found in the area.

Opportunities for solitude or primitive and unconfined recreation can be found to a high degree in some areas.

The Deep Creek, Sheep Mountain and Lake Fork areas are rugged, steep and have few trails, providing opportunities to experience a sense of seclusion and remoteness.

The portion of the evaluation area adjacent to La Garita wilderness has a high degree of opportunities for solitude or primitive and unconfined recreation, as well as those areas that have steep and rugged terrain with minimal trail access.

The trail systems provide access for those seeking remote backcountry hunting experiences in the fall, and Wannamaker Creek supports a hybridized Rio Grande cutthroat trout population for anglers.

Factors Considered and Process Used in the Evaluation

This large and diverse area provides habitat for the federally listed Canada lynx (threatened) and southwest willow flycatcher (endangered), and habitat for American marten, wolverine, boreal owl and goshawk. Other documented species include moose, American three-toed woodpeckers, marten, hermit thrush, brown creeper, blue grouse and ptarmigan. High quality deer/elk winter habitat and security areas can be found throughout the area.

The area includes a portion of the Colorado Natural Heritage Program Saguache Creek Potential Conservation Area. The Saguache Creek Potential Conservation Area is ranked as High Biodiversity Significance owing to its montane and subalpine willow carr associations within the creek’s floodplain and valley toe slopes.

Wannamaker Creek hosts a conservation population for Rio Grande Cutthroat Trout.

Ecological and Social Characteristics that Would Provide a Basis for Suitability for Inclusion in the National Wilderness Preservation System

In general, the area has long term, intact, and functioning ecological processes.

The area has a high degree of solitude.

This area would enhance the ecological effectiveness of the La Garita Wilderness by expanding the size.

Wason Park/Lower East Bellows (Polygon 25A and 25B) – 21,770 acres

Boundary Description

This area is approximately three miles north and east of the town of Creede, Colorado in Mineral County and is administered by the Divide Ranger District. The area is bounded to the north and east by the La Garita Wilderness, to the west and south by private and Forest lands. The area consists of upper tier and general roadless Wason Park Colorado Roadless Area and general roadless Lower East Bellows Colorado Roadless Area. An estimated 270 acres of the areas coincides with Management Area 4.23.

Geology, Topography, and Vegetation

The area and is characterized by gentle to steep alpine slopes and ridges, talus slopes, and glacial basins at higher elevation. Mid-elevation is composed of open benches and steep cliff walls into East and West Bellows Creeks. The Lower East Bellows Colorado Roadless Area is characterized by gentle to steep forested mountainous slopes and ridges with high-quality cliff habitat.

Current Uses and Management

The Lower East Bellows Colorado Roadless area is managed to preserve roadless values.

Primary access to the area is via National Forest System Roads 502 (East Willow Creek), number 503 (West Willow), number 501 (Dry Gulch) in the central and northern regions and National Forest System Road 600 (Pool Table) accesses the south.

This area is currently managed as backcountry and Colorado Roadless Area Rule which both emphasize a more primitive and roadless character.

There are no oil and gas leases or non-federal inholdings in the area. All existing trail in the designated area are non-motorized.

Ability to Protect Wilderness Characteristics

The area in the upper tier Wason Park Colorado Roadless Area generally appears natural. While some mining remnants are visible adjacent to the lower Bachelor Loop Road at its lowest elevations near Creede, Wason Park is otherwise free of any substantial unnatural impacts.

Factors Considered and Process Used in the Evaluation

The area has long term intact functioning ecological processes and represents an important landscape due to its adjacency to the wilderness on two sides creating a large expanse of relatively unfragmented and undisturbed habitats for a variety of wildlife species. It is in close proximity to a high use lynx area and likely provides habitat and denning habitat for the federally listed species.

Opportunities for solitude or primitive and unconfined recreation can be found in areas closer to La Garita Wilderness or away from trails, roads, and other evidence of current or past mining activities.

The town of Creede can be seen from the west side of the area, providing evidence of nearby civilization. Summer, fall and winter outfitter and guide activities are permitted in the area.

Unique features noted for this area include waterfalls, scenic values, and historic features.

There are outstanding scenic values are also associated with this area.

The area provides habitat for bighorn sheep, American marten and American three-toed woodpeckers. The upper tier Colorado Roadless Area also provides elk and mule deer summer, production, and winter concentration habitat. The Mountain and Farmer’s Creek area are winter concentration areas for elk and deer, bighorn sheep summer and winter habitat, habitat for moose, and pine marten. The Wason Park Colorado Roadless Area is also adjacent to priority habitat for moose in West Willow Creek. These areas provide a migration route for bighorn sheep from the Bellow Creek herd to the San Luis Peak and Bristol Head herds. The Lower East Bellows Colorado Roadless Area provides sheep summer and winter concentration and production habitat as well as elk and mule deer winter concentration range and moose habitat.

Ecological and Social Characteristics that Would Provide a Basis for Suitability for Inclusion in the National Wilderness Preservation System

Wason Park contributes to under-represented ecosystem types among existing wilderness areas on the Forest increasing the ecological representation Southern Rocky Mountain Montane-Subalpine Grassland.

Wason Park includes a pair of scenic waterfalls above Phoenix Park that are popular focal points for photographers.

Areas considered in both Alternative B and D

Beartown/Indian Ridge (Polygons 29) – 6,750 acres

Boundary Description

The area borders the Continental Divide and is adjacent to both the Rio Grande on the north and the San Juan National Forest to the south. The area is located in the headwaters area of upper Rio Grande, and borders the Continental Divide. The acreage considered in differs between alternatives B and D due to the establishment Management Area 4.23 – Congressionally Designated Trails. An estimated 1,300 acres of the areas coincides with Management Area 4.23. If this area were recommended the 1,300 acres would most likely be managed for both wilderness and congressionally designated trail values.

Geology, Topography, and Vegetation

Steep terrain, limited access and adjacency to designated wilderness create a sense of seclusion and remoteness in the area. The Indian Ridge Colorado Roadless is characterized by remarkably wild country with west facing, steep alpine and mountainous slopes and valley bottoms. The Beartown Colorado Roadless Area is characterized by east facing slopes, moderate to steep alpine slopes, ridges in the southern portion and toe slopes which fan into the valley bottoms.

Kobresia and forbs are found on the alpine ridges. The mountain slopes have subalpine fir and Engelmann spruce with Rocky Mountain whortleberry. Willow and sedges occur in the valley bottoms.

Current Uses and Management

The area is administered by the Divide Ranger District and is adjacent to the Weminuche Wilderness in San Juan County.

Two upper tier Colorado Roadless areas occur in the evaluation area, Beartown and Indian Ridge. The Bear Creek road (National Forest System Road 506) bisects the area and separates the two Colorado Roadless Area. National Forest System Road 520 (Rio Grande Reservoir) separates the area from the Pole Mountain/Finger Mesa upper tier Colorado Roadless Area to the north.

Approximately 3 miles of non-motorized trail that provides access for primitive recreation in the area.

There are no closed roads or motorized trails in the area, though there are private inholdings, a snow telemetry (SNOTEL) site and range improvements.

Ability to Protect Wilderness Characteristics

Evidence of historic mining and past timber harvest impact the apparent naturalness of the area.

Opportunities for solitude or primitive and unconfined recreation can be found in much of the area, especially away from roads and other authorized motorized uses.

This area is currently managed for backcountry and roadless characteristics, both of which emphasize a more primitive experience.

Challenges to managing for wilderness characteristics are related to existing motorized uses, the presence and maintenance of a SNOTEL site, private inholdings, and National Forest System Road

506 (Bear Town) that bisects the area. However, much of the area is adjacent to designated wilderness making the extension of wilderness management into the evaluation area possible.

Factors Considered and Process Used in the Evaluation

This area provides potential quality, relatively un-fragmented habitat and excellent denning potential for the federally listed Canada lynx (threatened). It also provides potential habitat for the American marten, and beaver, black bear, moose, and ptarmigan have been documented. This area also provides summer range for elk and mule deer.

The area has unfragmented habitat and excellent denning potential for lynx. It is also one of several contributing sources of water to the Rio Grande headwaters.

Ecological and Social Characteristics that Would Provide a Basis for Suitability for Inclusion in the National Wilderness Preservation System

Long-term ecological processes are intact and functioning in the polygon. Little fragmentation of habitat provides lynx denning habitat.

Existing roadless designation and backcountry management provide opportunities for solitude and a primitive experience.

Cumbres (Polygon 63a) – 7,490 acres

Boundary Description

The area is located on the southern portion of the Forest in Conejos County near the New Mexico border. The Conejos Peak Ranger District administers this part of the Forest.

The area is bordered to the northwest by the South San Juan Wilderness, to the east by the Los Caminos Antiguos Scenic Byway with the rest of the area surrounded by national forest.

Geology, Topography, and Vegetation

The area has steep hillsides and cliffs adjacent to the South San Juan Wilderness to the northwest, Los Caminos Antiguos Scenic Byway on the east and is surrounded by national forest throughout the rest of the area.

Current Uses and Management

There is evidence of timber harvest roads, historical mining and past fire history in the area.

Recreational opportunities currently include hiking, horseback riding, hunting, mountain biking and motorcycle riding. Some uses, including authorized motorized access, the Cumbres and Toltec Scenic Railroad, logging activities and proximity to Highway 17 may impact opportunities for solitude.

Ability to Protect Wilderness Characteristics

Most of the area is natural in appearance with the unit’s Ponderosa pine-grasslands providing a good example of a pine forest in excellent condition. There is some evidence of historical mining, timber harvest, roads, and past fire activity in the area. Cattle and sheep grazing are permitted and some range improvements include fencing and water development.

The area has five trails that provide non-motorized access to the South San Juan Wilderness.

Once away from the non-motorized trails and roads, visitors can get a feeling of remoteness and seclusion due to the proximity and access to the South San Juan Wilderness.

Approximately 5 miles of the Elk Creek Trail would become a wilderness trail.

This area is currently managed as backcountry and roadless which emphasize primitive experiences.

This area could be managed to preserve wilderness characteristics with non-motorized trails and adjacent South San Juan Wilderness. The Cumbres upper tier Colorado Roadless Area aids in protecting the wilderness character. The Elk Creek trail would have minimal management changes to remove mountain bike riding when congressionally designated.

Factors Considered and Process Used in the Evaluation

This is a high use area for federally listed Canada lynx (threatened) which have been reestablished in the South San Juan Mountains and documented. Habitat for Mexican spotted owl (threatened) and southwestern willow flycatcher (endangered) is also present.

The area provides habitat for bighorn sheep, mule deer summer range, and elk production areas near Duck and Rock lakes. The steep north facing hillsides also provide areas of cover and refuge for elk. It is considered overall range for black bear.

Addition of this area would notably expand the range of ecosystems present in the existing South San Juan Wilderness.

The area also provides traditional cultural plant harvest opportunities.

Chama Basin was removed from the area and is included as a special interest area.

Ecological and Social Characteristics that Would Provide a Basis for Suitability for Inclusion in the National Wilderness Preservation System

This area has long term, intact, and functioning ecological processes.

Sangre de Cristo/Pole Creek/Crestone/Cotton Creek/Hot Springs/ Miller Creek/Butterfly (Polygons 1A, 2, 3 A-F) – 35,090 acres

Boundary Description

This area is locates in the eastern portion of the Forest in Saguache and Alamosa Counties. The northern part is administered by the Saguache Ranger and the Conejos Peak Ranger District manages the most southern part. The area borders the Forest boundary to the west and Sangre de Cristo Wilderness to the east and north. The area extends south to the Forest Service boundary.

Geology, Topography, and Vegetation

Vegetation ranges from oak brush in lower elevations to pinyon-juniper in mid elevations, to Engelmann spruce and subalpine fir in higher elevations with Aspen intermingled throughout.

Kit Carson Peak and the north and west sides of Blanca Peak and Little Bear Peak lie within the proposed wilderness area. All three peaks are more than 14,000 feet high.

Current Uses and Management

The area considered encompasses the Pole Creek, Crestone, Cotton Creek, Hot Springs, Miller Creek and Butterfly Colorado Roadless Areas. The Dorsey Creek Colorado Roadless area was excluded from consideration.

There is no authorized or permitted grazing within the area.

The estimated 1,400 acre Mill Creek Research Natural Area occurs in the Crestone Colorado Roadless Area. This Research Natural Area has extensive, high quality pinyon/juniper woodland ecosystems on the relatively gentle slopes of alluvial fans and steeper bedrock extending up to the 9,000 feet and are the principal feature of the area. Additionally, mixed conifer and subalpine forest extend up to treeline on Gibson Peak and subalpine grasslands blend into higher elevation alpine vegetation above treeline. There are no trails in this area.

Management as backcountry and for roadless characteristics emphasize a more primitive experience.

Ability to Protect Wilderness Characteristics

The majority of the area appears relatively natural, with a few exceptions in isolated areas. The area’s long-term ecological processes are intact and operating similar to the adjacent Sangre de Cristo Wilderness.

Overall, solitude or primitive and unconfined recreation opportunities can be found throughout this area. Several isolated areas experience high numbers of visitors during the summer and hunting season as well as fall and summer outfitter and guide use that could impact opportunities for solitude.

Most of the area is bordered by designated wilderness to the east, Bureau of Land Management wilderness study area, other Bureau of Land Management lands and private property to the west, Great Sand Dunes National Park and Preserve to the south, buffering much of the area from activities and developments that would impact opportunities for solitude.

Opportunities for primitive recreation can be found through the area including hiking, climbing, hunting, nature viewing and bird watching. The area includes three popular 14ers providing opportunities to experience a degree of challenge and primitive recreation in a rugged and remote environment.

Some uses may impact solitude including authorized motorized access from cherry stemmed motorized access points.

Factors Considered and Process Used in the Evaluation

There are several cherry stemmed roads that provide access to developed facilities, private lands and mining claims within the area.

The area provides habitat for the federally listed Canada lynx (threatened) as well as habitat for American marten, bighorn sheep and wolverine. The area is a key bighorn sheep lambing and wintering area and provides winter range for mule deer and elk. Additionally, the Pole Creek Colorado Roadless Area provides maternity roosts for Townsend’s big-eared bat. The area is also important for the Brazilian free-tailed bats that come from the Orient Mine colony.

In some areas, evidence of past prospecting, mining and timber harvest activities are noticeable, but do not detract from the overall apparent naturalness of the area. There are a few miner and trapper cabins scattered throughout the area as well as scattered private lands and inholdings.

Cultural and significant sites can be found throughout the area and include Mount Blanca, which is sacred to the Navajo, Ute, and Jicarilla Tribes. It is an important anchor point within the cultural landscape of the Upper Rio Grande pueblos. The peak marks the eastern boundary of the *Dinetah*, or Navajo homeland. This area was identified as significant during tribal consultation.

Several factors were considered when reviewing the southern flank of Mt. Blanca as proposed wilderness in Alternatives B and D. During the assessment phase of the revision process, the Navajo Nation requested to be a cooperating agency because of its vested interest in the protection of Mt. Blanca as a sacred site and place important Navajo cosmology and the practice of religion. The Jicarilla Apache Nation and the Southern Ute Tribe also affirmed their spiritual affiliation to the mountain during the assessment phase. A special meeting between these three tribes, the Rio Grande National Forest, the San Luis Valley Field Office Bureau of Land Management, the Great Sand Dunes National Park and Preserve and the U.S. Fish and Wildlife Service was held in Ft. Garland spring of 2015. This gathering informed the draft potential management approaches developed for the plan within areas of tribal importance section. Two subsequent meetings with the tribes focused on weighing alternative prescriptions and management strategies for the portion of the mountain that the Forest administers.

Alternatives discussed included a Special Interest Area, a recommended wilderness designation and/or a traditional cultural property designation. To meet objectives of the tribes in maintaining as much of the mountain as ‘pristine’ as possible, a proposed wilderness designation affords the greatest protection. It was agreed that the mountain would be evaluated as a traditional cultural property in a separate process during the life of the plan. Additionally, the same area is recommended for wilderness designation in a citizen proposal in solidarity with the tribes for its cultural and spiritual values.

Ecological and Social Characteristics that Would Provide a Basis for Suitability for Inclusion in the National Wilderness Preservation System

In general, the steep, rugged and remote nature of much of the area provides a feeling of seclusion and inaccessibility throughout the year.

The area does have active irrigation diversion structures as well as the popular Lake Como road accessing Blanca Peak.

Tobacco Lakes/Gold Creek/Cascada Creek) (Polygons 57 and 55) – 3,030 acres

Boundary Description

The area is located on the southwest border of the Forest and is managed by the Conejos Peak Ranger District. This area includes a portion of the Tobacco Lake (both upper tier and roadless) and upper tier Gold Creek/Cascade Creek Colorado Roadless Areas in Conejos County. It is bordered on the south by the South San Juan Wilderness, Platoro Reservoir on its western boundary and Forest Service lands along the remaining boundaries. More area is considered in alternative D versus alternative B.

Geology, Topography, and Vegetation

This area is characterized by high-elevation mountainous terrain with Engelmann spruce/subalpine fir stands intermingled with large, open meadows and steep drainages sloping into Platoro Reservoir. The area consists of steep drainages and hillsides not conducive to travel by vehicles.

Current Uses and Management

General access to this area is by National Forest System Road 105/l 00 on the eastern boundary and National Forest System Road 247-T to the western boundary.

Approximately 60 acres of Colorado Roadless are in the area. Additionally, eligible wild rivers, under the Wild and Scenic Rivers Act are close by but not in the area being considered.

Ability to Protect Wilderness Characteristics

The area's landscape is relatively natural in appearance with minimal human disturbance.

This area is currently managed as backcountry and roadless which both emphasize a more primitive experience.

There are no oil and gas leases and non-federal inholdings in the proposed area.

Factors Considered and Process Used in the Evaluation

This area most likely contains Canada lynx denning sites and the steep north facing slopes and drainages are potential lynx reproduction sites and hunting grounds. The area is also a key area for bighorn sheep and provides habitat for the American marten. The Canon Diablo area provides elk summer range.

Portions of the area document high use by Canada lynx and this was one of the core areas where lynx established after reintroduction.

The area addition includes a portion of the Colorado Natural Heritage Program Adams Fork of the Conejos River Potential Conservation Area. This Potential Conservation Area includes riparian habitat to support the Rio Grande cutthroat trout, and is ranked as High Biodiversity Significance.

Ecological and Social Characteristics that Would Provide a Basis for Suitability for Inclusion in the National Wilderness Preservation System

With few roads, trails, or other uses in the area, one can obtain a sense of seclusion and solitude in the area: especially when adjacent to the wilderness or in the Colorado Roadless Area.

The area addition enhances the ecological effectiveness of the South San Juan Wilderness by expanding the size of the protected area.

References

USDA Forest Service. 1982. Rio Grande National Forest: Conejos Wild and Scenic River Study – Final Environmental Impact Statement. Available in the project record at the Rio Grande National Forest Supervisor's Office in Monte Vista, Colorado.

Block, J.R. 1982. Letter from Secretary of Agriculture John R. Block to President of the United States Ronald W. Reagan, dated June 11, 1982, regarding the segment of the Conejos River downstream from Platoro Reservoir for 2 miles. Available in the project record at the Rio Grande National Forest Supervisor's Office in Monte Vista, Colorado.

USDA Forest Service. 1994. Rio Grande National Forest: Analysis of the Management Situation, July 1994. Available at the Rio Grande National Forest Supervisor's Office in Monte Vista, Colorado.

USDA Forest Service. 1996. Rio Grande National Forest: Revised Land and Resource Management Plan, 1996. Available at the Rio Grande National Forest Supervisor's Office in Monte Vista, Colorado.

USDA Forest Service and USDI National Park Service. 2009. Environmental Assessment, Baca Mountain Tract and Camino Chamisa Project. Prepared by Rio Grande National Forest and Great Sand Dunes National Park and Preserve. Accessed April 17, 2017, at https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd508050.pdf

USDA Forest Service 2016. Rio Grande National Forest – Draft wilderness evaluations. Prepared by Rio Grande National Forest, Monte Vista, Colorado. Accessed August 11, 2017, at: https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd521710.pdf

Appendix B. Timber Suitability and Analysis

Lands that May be Suited for Timber Production

Lands that may be suited for timber production were determined using the criteria in the Land Management Planning Handbook FSH 1909.12 Chapter 60. These areas and associated acreage were determined by starting with the total area of the Rio Grande National Forest and removing areas that are not suited for timber production, listed below:

- In-holdings
- Level 2 through 5 roads
- Lands not suited for timber production because timber production is prohibited or the lands are withdrawn from timber production:
  - Wilderness areas
  - Eligible wild rivers
  - Colorado Roadless areas
  - Research Natural Areas
- Lands on which technology to harvest timber is not currently available without causing irreversible damage:
  - Certain soil map units having "high mass movement potential" were removed due to this criteria. The criteria differed based on geographic area.
    - In the Sangre de Cristos, the following Soil Resource Inventory codes were removed: 410S, 605Y, 625S, 670S, 704S, 835X.
    - On the west side (everywhere except the Sangre de Cristos), soils were removed using a field called mass movement potential, with the exception of those polygons in the Cumbres area that have a Soil Resource Inventory of 139 or 151.
    - Note: In the 2000 amendment, Soil Types 460 and 750M were removed in only particular locations. This was not done because the 460 code is no longer used and because the locations where 750M was unsuitable had already been removed in prior steps.
- Lands on which there is no reasonable assurance that lands can be adequately restocked within 5 years of final regeneration harvest:
  - Elevations above 11,000 feet with south and southwest aspects
  - Elevations below 9,500 feet with south and southwest aspects
  - Areas with greater than 33 percent rock
- Land that is not Forest land
  - Areas with less than 10 percent canopy cover of trees were removed in this step. Areas that were formerly occupied by trees but with low canopy cover due to recent disturbance were not removed if tree species were regenerating.
- Areas with nonindustrial species, such as limber pine, bristlecone pine, pinyon, and juniper.
- True riparian areas (defined as an FSVeg Spatial local type of RIP (riparian) and cover type of grass, forb, or cottonwood).

The final area considered *may be suitable* for timber production is 499,936 acres.

Sustained Yield Limit Calculations

The sustained yield limit (SYL) is the amount of timber that can be produced on all lands that *may be suitable* for timber production, assuming all of these lands were managed to produce timber without considering other multiple uses or fiscal or organizational capability. The sustained yield limit was calculated using the Forest Vegetation Simulator (FVS, 7/19/16 version), the Forest Service's national forest growth and yield model. Site information from the stand exams collected over the last 20 years was used for this analysis. Sustained yield limit was calculated by the following strata, with the number of stands used in parentheses:

- Spruce-fir (405 stands)
- Aspen (103 stands)
- Lodgepole pine (59 stands)
- Ponderosa pine (64 stands)
- Mixed-conifer (243 stands)

Additional areas were also included separate from these main strata. This includes 1) 1M and 2S areas with low canopy cover (10 to 25 percent) that key out as grasslands or other non-timber types and which are not previously treed and 2) areas with low canopy cover (less than 25 percent) that have had recent disturbance but were previously treed.

Results from each stand were averaged together to get strata averages.

The management system, rotation age/entry interval, and associated harvest volume (cubic feet per acre) that were used to determine the sustained yield limit are listed in Table 119.

Table 119. Assumptions used for the sustained yield limit calculation

Strata	Management System	Rotation age / Entry Interval (years)	Acres of May be Suitable Lands	Harvest Volume (cubic feet/acre)
Spruce-fir	Uneven-aged – Group Selection	160	165,756	2,932
Lodgepole pine	Even-aged - Clearcut	120	22,198	2,697
Aspen	Even-aged - Clearcut	120	114,979	2,178
Mixed-conifer	Even-aged - Shelterwood	140	106,807	1,569
Ponderosa pine	Uneven-aged – Individual Tree Selection	30	18,542	400
Other - 1M and 2S		200	20,211	500
Other – timber		200	51,388	1,000
Other – Rock – Bare Soil	--	--	55	0

Numerous adjustments were made in Forest vegetation simulator to determine the appropriate harvest volume. These adjustments included factoring in defect, using local merchantability specifications, adjusting the stand density maximum values, calibrating tree growth based on collected tree growth data, and capping tree size based on observed tree sizes. Mortality due to insects and disease, such as spruce beetle, spruce budworm, Douglas-fir beetle, mountain pine beetle and/or engraver beetles, and tent caterpillar, aspen disease, and wood borers was included. Additional details on forest vegetation simulation assumptions are available on request.

The estimated sustained yield limit is 7,374,937 cubic feet per year or 73,749 CCF per year.

Lands that Are Suited for Timber Production

The land suited for timber production under each alternative was defined using the criteria below. Starting with the may be suitable timber areas, the following areas were removed because timber production is not compatible with the desired conditions and objectives for these areas:

- Recommended wilderness, research natural areas, and wild rivers for the specific alternative
- National Scenic and Historic Trails – Continental Divide National Scenic Trail and Old Spanish Trail, including a ½ mile buffer on each side
- National Recreation Trails - Lost Fork and West Lost Fork, including a ½ mile buffer on each side
- Scenic rivers
- Current and proposed special interest areas (Management Area 3.1)
- Ski-based resorts (Management Area 8.22)
- Backcountry areas (Management Area 3.3) in any alternatives that have this

Two main timber suitability changes from the 1996 Rio Grande Revised Land and Resource Management Plan pertain to the Grassland Resource Production areas (Management Area 6.6) and Bighorn Sheep management areas. The Grassland Resource Production areas are being considered suitable for timber production, a change from the 1996 plan, where they were not suitable. In addition, most, but not all, of the Bighorn Sheep management areas in the 1996 plan were merged into the Big Game Winter Range management area (Management Area 5.41) and are now considered suitable for timber production as a result.

All areas of the suitable timber base were included because timber production is allowed and is consistent with the desired conditions and objectives for the area. However, some inclusions in the suitable timber base may not be currently feasible for timber production. This includes areas that are very difficult to reach (either because of distance or because they lack an appropriate transportation system), areas that would require helicopter logging, cable yarding, and areas that are extremely isolated.

Maps of the areas that are suitable for timber production under each alternative are contained on the DVD that is located at the back of the Rio Grande National Forest Plan Revision Draft Environmental Impact Statement.

Suitable timber acres are listed by alternative in Table 120.

Table 120. Suitable timber acreage for alternatives A through D

[Reported in acres]

	May Be Suitable	Alternative A	Alternative B	Alternative C	Alternative D
Acres Suitable for Timber Production	499,936	320,567	468,311	480,683	401,414

Appendix C. Species of Conservation Concern Presence and Concern for Persistence

Background

The 2012 Planning Rule and Forest Service Handbook 1909.12, Chapter 20, require that species of conservation concern are identified for the planning area. More detailed analysis of these species can be found in Chapter 3 of the draft environmental impact statement for the forest plan. The 2012 Planning Rule requires the Forest Service to consider species that are known to occur in the planning area and that are established or are becoming established. We recognize that in practice, data on rare and declining species is often variable and incomplete, which complicates making confident presence/absence conclusions and introduces some potential risk for species not further considered for species of conservation concern status (or removing a species from the list).

For the purposes of "known to occur," we have elected to require a record for a species on the planning unit to qualify for species of conservation concern status. Species that exist close to the planning area but that have not been recorded on the planning area are not considered to be known to occur on the planning unit. Species that are thought to be present in the plan area, but that have not been documented there are also not considered as known to occur. The species must be documented on National Forest System lands within the boundary of the Forest. Species identified as Forest species of conservation concern and rationale for inclusion are contained in Table 121. All information pertains to the planning area.

The 2012 Planning Rule does not require the Agency to consider those that are only transient or accidental, or that are well outside existing range of the species. Only species that are considered established or are becoming established can be species of conservation concern.

An overview for each species has been prepared and is available on the Forest's webpage. The overview considers each species':

- Status
- Taxonomy
- Distribution, abundance, and trend in the planning area
- A brief description of the natural history and key ecosystem functions
- Overview of ecological conditions for recover, conservation, and viability
- Threats and other risk factors.

Several criteria can be used to determine if a species is established. For plants, "established" means that it has roots in the ground or is otherwise attached to a substrate in the planning area, or has viable seeds in the seed bank produced by a plant that grew in the planning area in the last 20 years or so. Seeds do not remain viable forever, at least not in a naturalistic outdoor setting; the presence of viable seeds is generally an indication that the plants that produced the seeds were alive no more than a few decades ago.

For wildlife species, the determination of what is "established" is less clear. Reproduction by animals on the planning unit would certainly be considered a sign of that species being established. Frequent presence on the Forest, even if the animal breeds elsewhere, would also be considered established. A single record for a species in the planning area may or may not qualify it for species of conservation concern status, depending on the overall context of the available information for that species when considering the record.

Occurrence data have been collected from multiple sources, including the Colorado Natural Heritage Program database (continually updated, the Forest Service acquires an updated copy once a year), Herbarium records, mist-netting and sight/song bird surveys, and specialist reports.

Information from more detailed assessments and other sources used in determining eligibility for status as a species of conservation concern is summarized in Table 121 and Table 122.

Links are provided in digital versions of the tables to take readers to overview assessments that are available on the Forest website. Information contained below applies to the Forest unless stated otherwise.

Most references contained here can be found in the *References Cited* section of the *Draft Environmental Impact Statement* or in the species overviews that are linked below. Those references not listed in those locations are listed below the tables.

Table 121. Current species of conservation concern and evaluation criteria

Category	Species	Evidence of Occurrence	Substantial Concern About the Species Capability to Persist over the Long Term
Invertebrates	Western bumblebee *Bombus occidentalis*	Located in 2016 by Rio Grande NF and USFS Region 2 staff members during botany surveys.	This species has undergone a severe, range-wide population decline over the past decade, estimated at 40-90 percent. (Cameron et al. 2011) The population on the Forest appears to have mirrored this decline, which is on-going. The Fish and Wildlife Service currently has this species under review for possible listing under Endangered Species Act. The subspecies *occidentalis* found in the Rocky Mountain Region has declined about 70-99 percent since the late 1990s. The main cause of declines is thought to be the effects of a microsporidian *Nosema bombi* and an imported protozoan parasite from Europe. Other causes of decline include land use changes and habitat loss, changes in nectar flora, overgrazing, poorly timed fire in suitable nesting habitat, changes to temperature and precipitation regimes, competition with honey bees, and effects of pesticides especially persistent neonicotinoids. All of these threats occur.
Invertebrates	White-veined arctic butterfly *Oeneis bore*	Two records on the forest from 2004, one in Hinsdale County and one in Saguache county. Records verified by USGS Northern Prairie Wildlife Research Center. One record from 1996.	As with many tundra relict species, changes in temperature and precipitation regimes could be a threat, as temperatures warm, species can move north or uphill to cooler refuges. In the case of species that exist on tundra in the southern Rockies, moving uphill is not an option as local populations already only survive on mountain tops. It is possible that warmer temperatures could lead to a loss of nectar plants to the butterfly, or the timing of the nectar bloom is changed relative to the life history needs of *O. bore.* Climate change vulnerability assessments in the vicinity of the Forest note that the white-veined arctic could be lost.
Amphibians	Boreal toad *Anaxyrus boreas*	Boreal toads have been reported at 10 sites in the past 20 years with the most recent observations occurring in 2014.	Primary localized threats on the Forest involve chytrid fungus with 4 of 5 known sites testing positive. Other local concerns involve water and air quality factors, nonnative species, recreation management and perhaps fire and timber management in localized areas. Climate change vulnerability assessments for areas surrounding the Forest have determined that this species is “highly vulnerable” to negative impacts from changes in temperature are precipitation regimes.
Fish	Rio Grande chub *Gila pandora*	Present in 3 stream segments; surveys by Colorado State University	The primary threats to this species include reduction of stream flows, increased sediment loads, and competition with and predation by nonnative fish. The limited remaining habitat for this species also renders the species at risk from stochastic events. NatureServe ranks this species as “Critically Imperiled” and Colorado Parks and Wildlife lists the species as “Tier 1, Species of Greatest Conservation Need”. Currently under review by the Fish and Wildlife Service for listing under the Endangered Species Act.

Category	Species	Evidence of Occurrence	Substantial Concern About the Species Capability to Persist over the Long Term
Fish	Rio Grande cutthroat trout *Oncorhynchus clarkia virginalis*	Present in 27 stream segments and 2 lakes.	Some recorded presence contradicts dramatic decline over its historic range that is now limited to small, isolated populations in the upper Rio Grande drainage in Colorado. Many of these populations are not self-sustaining and very vulnerable to habitat degradation from a variety of causes, competition and hybridization with non-natives, over-utilization, and stochastic events. The Climate Change Vulnerability Assessment for the Colorado Bureau of Land Management described this species as having greatly increased vulnerability in its physiological, thermal, and hydrological niches due to potential changes in temperature and precipitation patterns. This species is wholly dependent upon human management to survive. Under current conditions, if management activities were to cease, the subspecies would be expected to resume a declining trend as a result of invasion of populations by non-native salmonids, stochastic environmental events, whirling disease, and the demographic and genetic factors associated with small, isolated populations (Pritchard and Cowley 2006). Species is ranked by Colorado Parks and Wildlife as Species of Greatest Conservation Need Tier 1.
Fish	Rio Grande sucker *Catostomus plebeius*	Currently known from 9 stream segments.	Competition with and predation by non-native species are extensive threats to the health and viability of Rio Grande sucker populations. Nonnative predators include northern pike and brown trout. The introduced white sucker tends to be well adapted to a variety of degraded environmental conditions, allowing it a competitive advantage on a spatial or temporal scale over the Rio Grande sucker. The larger white sucker competes with Rio Grande sucker for available food sources (periphyton and macroinvertebrates), and also has the ability to hybridize with Rio Grande sucker (Rees and Miller 2005).
Birds	Boreal owl *Aegolius funereus*	Eleven records in the past 20 years.	Boreal owls are threatened by loss of nesting habitat and changes in prey base resulting from substantially beetle killed spruce-fir habitat. Resulting in a reduction of closed canopy habitat available. Dramatic change (90 percent) in spruce-fir landscape conditions suggest potential declining habitat trend and viability. Other risk factors that may affect species density and distribution are likely to include large-scale stand replacement fire, and large-scale insect outbreaks. The Gunnison Basin Climate Change Vulnerability Assessment indicates that this species is “Highly Vulnerable” to changes resulting from changes in temperature and precipitation regimes. Colorado Natural Heritage Program S2 (Imperiled), Colorado Parks and Wildlife Species of Greatest Conservation Need Tier 2.

Category	Species	Evidence of Occurrence	Substantial Concern About the Species Capability to Persist over the Long Term
Birds	Brewer's sparrow *Spizella breweri*	10 records in the past 10 years, most recently in 2014.	Rangewide concerns for substantial declines in sagebrush and mountain shrub habitats. The primary concern regarding the persistence of Brewer's sparrow is the continued decline of the species numbers in the area surrounding the Forest as well as pinyon juniper encroachment in the limited suitable sagebrush habitat. Trend estimates show significant decreases in relative abundance from 1966 to 2002. Detection frequencies during this period on routes in southern and eastern Colorado declined. Sauer et al. (2011) report significant declining trends of this species in the Southern Rockies/Colorado Plateau for the period 1966-2010. In addition, the Climate Change Vulnerability Assessment for the Colorado Bureau of Land Management shows that the species may experience a "Greatly Increased" vulnerability" due to the impacts that changes in temperature and precipitation regimes may have on the species that influence the habitat features required by Brewer's sparrow.
Birds	Flammulated owl *Otus flammeolus*	65 records in the past 20 years, the most recent observations in 2014	Flammulated Owls are threatened by loss of suitable nesting habitat. Replacement of open, old-growth ponderosa pine and mixed conifer forest with younger, high-density vegetation is considered detrimental to this species. Immediate threats include the loss of remaining areas of open, mature forest habitat due to departure from historic fire regimes and landscape scale disturbances such as stand replacement fire and bug infestations.
Birds	Northern goshawk *Accipiter gentiles*	As of 2015, at least 15 known active nesting territories, three historic territories, and two other potential territories	Approximately 90 percent of the species habitat in the Southern Rockies is found on National Forest System lands. This species has experienced a decline in active nests over time. The loss of large nest trees in spruce-fir habitat is correlated with the impacts of beetles. A recent landscape study conducted in the San Juan Mountains of Colorado suggests substantial changes in landscape structure and fragmentation of mature forest have occurred in this area between 1950 and 1993. Many factors contribute to the changed condition including fire exclusion and maturing stand conditions in ponderosa pine. If this trend is representative of regional trends, goshawk habitat is probably declining in Region 2 (Kennedy 2003). Increase in younger tree age classes and loss of older trees associated with beetle kill are also a concern. Extensive habitat changes due to impacts of the bark beetle raises questions about long-term persistence on the forest and surrounding area. Detections and nest territory occupancy has declined in recent years based on project work and monitoring.
Bird	Olive-sided flycatcher *Contopus cooperi*	30 records	The concern for persistence of this species is based on a decline range-wide and forestwide. This species has experienced at least a 50 percent decline based on Rocky Mountain Bird Observatory/Bird Conservancy of the Rockies data. Similar patterns of decline are evident on the forest based on results of local Breeding Bird Survey results over the past decade. Primary species habitat on the Forest (spruce-fir) has experienced a 90 percent decline.

Category	Species	Evidence of Occurrence	Substantial Concern About the Species Capability to Persist over the Long Term
Birds	Peregrine falcon *Falco peregrinus anatum*	22 records with at least 12 eyries identified, of which six are active eyries, five are recent or historic eyries, and one is potential	Local eyrie occupancy is declining. Delisted population is still monitored by the USFWS. Recovery of this species in other areas does not appear to be mirrored on the Forest. Stochastic impacts from recreational climbing have potential to cause nesting failure. Due to the small numbers of this species Forestwide, even a small number of failed nests could result in the extirpation of the species.
Birds	Southern White-tailed ptarmigan *Lagopus leucurus altipetens*	26 records	In the Rocky Mountains, approximately 95 percent of occupied ptarmigan habitats are on federal lands, 85 percent of which are national forest system lands in Colorado and Wyoming. Region 2 populations are isolated from nearest northerly populations by long distances. As with many tundra relict species, changes in temperature and precipitation regimes could be a threat, as temperatures warm, species can move north or uphill to cooler refuges. In the case of species that exist on tundra in the southern Rockies, moving uphill is not an option as local populations already only survive on mountain tops. Warmer temperatures could lead to a loss of alpine tundra on the Forest. In this case, the Southern white-tailed ptarmigan could be lost from the Forest. Climate change vulnerability assessments for areas surrounding the Forest have determined that this species is “Highly Vulnerable” to negative impacts from changes in temperature are precipitation regimes. The species is under a 12 month review for possible Endangered Species Act listing by the Fish and Wildlife Service due to concerns for the present or threatened destruction, modification, or curtailment of the species’ habitat or range due to changes to temperature and precipitation regimes. (Review is still ongoing as of 16 May 2017); state Tier 1 Species of Greatest Conservation Need.
Mammals	American marten *Martes americana*	9 records	Marten is a closed canopy species therefore the 90 percent mortality in spruce fir, due to beetle kill, creates a concern. This change in suitable habitat, including related declines in associated prey species such as the red squirrel as documented by Colorado Parks and Wildlife (Ivan 2017), creates a persistence concern for the species.
Mammals	Fringed myotis *Myotis thysanodes*	Roost site records include an underground mine occurring at 8,941 ft. elevation. Acoustic surveys have positively identified the species at a low elevation ponderosa pine stand in the Hot Creek RNA in 2013.	Concern for long-term persistence of this species stems from white-nose syndrome. Although not yet detected within Colorado, the disease continues to spread west. The Agency has measures in place to protect bat roosts and maternity sites from white-nose syndrome, but it remains possible for the disease to infect colonies despite these measures. Based on patterns occurring elsewhere a loss of 80 to 90 percent of the affected bat species could be realized which includes the potential loss of entire colonies. Protection and maintenance of roost sites is also a potential issue. Since only one colony occurs on the Forest, extirpation remains possible. In addition, the Climate Change Vulnerability Assessment for the Colorado Bureau of Land Management suggests that fringed myotis may experience a “slight Increase” in vulnerability due to changes in its’ hydrological niche and physical habitat due to changes in temperature regimes and precipitation patterns.

Category	Species	Evidence of Occurrence	Substantial Concern About the Species Capability to Persist over the Long Term
Mammals	Gunnison's prairie dog *Cynomys gunnisoni*	8 known records in two general areas.	The persistence concern for this species is sylvatic plague, which often wipes out most if not all of infected colonies and often involving much larger populations than found on the Forest.
Mammals	Northern pocket gopher *Thomomys talpoides agrestis*	Confirmed presence of the vulnerable *agrestis* subspecies (CNHP 2006)	Stochastic human or natural events could extirpate this species due to the very small size of the area occupied by this subspecies. The subspecies is also very rare across its range, which is limited to the San Luis Valley (endemic).
Mammals	Plains pocket mouse *Perognathus flavescens*	Two recent records (CNHP)	The concern for persistence is due to the limited habitat and very small area occupied by the species. Due to this small size, stochastic natural or human caused events could extirpate this species.
Mammals	River otter *Lontra canadensis*	Records from 2004 and 2010	Otters are threatened with extirpation mostly because they are already uncommon, and as such they are susceptible to stochastic events and human harassment. Relatively recent records indicate otters may be recolonizing the valley after an extended absence, perhaps stimulated by state recovery efforts. Opportunities exist to support that re-establishment through ongoing special habitat management attention.
Mammals	Townsend's big-eared bat *Corynorhinus townsendii townsendii*	11 records in the past 20 years.	Concern for the persistence stems from white-nose syndrome. Although not yet detected within Colorado, the disease continues to spread west. The Agency has measures in place to protect bat roost and maternity sites from white-nose syndrome, but it remains possible for the disease to infect colonies despite these measures. An 80 to 90 percent loss of the species could be realized, including the loss of entire colonies. In addition, Climate change vulnerability assessments for the state indicate that this species may experience a slight increase in vulnerability due to changes in its physiological hydrological niche and physical habitat due to changes in temperature regimes and precipitation patterns.
Plants	*Black Canyon gilia Aliciella penstemonoides*	Known from 6 occurrences. Last observed in 1998.	This species is found in rocky areas with a spruce-fir overstory, the approximately 90 percent mortality of spruce is a threat to this species because of the resulting loss or alteration of this species' habitat from the loss of that canopy cover. Climate change vulnerability assessments for areas surrounding the Forest indicate that this species is moderately vulnerable to negative impacts from changes in temperature and precipitation regimes, particularly because there are limits to dispersal. Forest occurrences are small and isolated populations which are susceptible to genetic drift and stochastic events.
Plants	*Stonecrop gilia Aliciella sedifolia*	This G1 species is known from 2 locations. Last observed in 2016. Of the entire global distribution of this species, 2 of the 3 occurrences are on the Forest.	Climate change vulnerability assessments for areas surrounding the Forest indicate that this species is extremely vulnerable to negative impacts from changes in temperature and precipitation regimes because of the loss of alpine habitat. Of the entire global distribution of this species, 2 of the 3 occurrences are on the Forest.

Category	Species	Evidence of Occurrence	Substantial Concern About the Species Capability to Persist over the Long Term
Plants	Brandegee milkvetch *Astragalus brandegeei*	Known from 2 occurrences. Both observed in 1986, aerial imagery indicates no evidence that the bristlecone habitat at these 2 locations has changed, thus there is no evidence to assume that the species is no longer present.	Climate change vulnerability assessments for areas surrounding the Forest indicate that the bristlecone pine habitat of this species is highly vulnerable to negative impacts from changes in temperature and precipitation regimes across Colorado. Isolated and small Forest populations are susceptible to threats from genetic drift and stochastic events.
Plants	Ripley's milkvetch *Astragalus ripleyi*	There are 22 known occurrences of this species last observed in 2016. The entire global distribution of this species is on or near the Forest.	Climate change vulnerability assessments for areas surrounding the Forest indicate that this species is extremely vulnerable to negative impacts from changes in temperature and precipitation regimes. This vulnerability is due to likely reductions in suitable habitat as well as alterations in the disturbance regime and its restriction to an uncommon geology.
Plants	Northern moonwort *Botrychium pinnatum*	Known from 3 occurrences, most recent observation in 2003.	Climate change vulnerability assessments for areas surrounding the Forest indicate that this species is moderately vulnerable to negative impacts from changes in temperature and precipitation regimes that would result in the loss of the alpine portion of this species' habitat. Documented threats to this species include disturbance from vegetation management as well as sedimentation from roads. This species also occurs in spruce-fir and is threatened by the loss or alteration of that habitat from over story mortality. Aerial imagery from 2016 indicates that the canopy cover of spruce at all 3 of the occurrences of this species have been lost. One of the occurrences consists of a single individual while the largest is only 75. Small and Isolated populations are susceptible to genetic drift and stochastic events.
Plants	Least moonwort *Botrychium simplex*	Known from a single occurrence. Last observation in 1995. Aerial imagery shows that the habitat at this occurrence is unchanged since 1995 and thus there is no evidence to assume the species is no longer present.	This species is found in spruce-fir habitat which has undergone a 90 percent mortality event resulting in a loss or alteration of this species' habitat. Aerial imagery from 2016 indicates that the canopy cover of spruce at this species' single occurrence has been lost. Climate change vulnerability assessments for areas surrounding the Forest indicate that the spruce-fir, fen, and montane riparian habitats are moderately threatened by changes in temperature and precipitation regimes. The single Forest occurrence consists of only 17 individuals. Small and isolated populations are susceptible to threats from genetic drift and stochastic events. Species with single occurrences have particular viability concerns because a single event can remove the species entirely.

Category	Species	Evidence of Occurrence	Substantial Concern About the Species Capability to Persist over the Long Term
Plants	*Downy Indian-paintbrush* *Castilleja puberula*	This G2 species is known from 3 locations, the most recent observation is 2006.	Climate change vulnerability assessments for areas surrounding the Forest indicate that this species is extremely vulnerable to negative impacts from changes in temperature and precipitation regimes, has a limited dispersal ability, is dependent on snow and ice, and has migration barriers. Additionally, climate change vulnerability assessments for areas surrounding the Forest indicate that the alpine habitat of this species is considered to be highly vulnerable to negative impacts from changes in temperature and precipitation regimes in southwest Colorado and this species is thus threatened by the loss of its alpine habitat. One of the observations on the Forest is a few individuals scattered over a hundred acres. Small and isolated populations are susceptible to threats from genetic drift and stochastic events.
Plants	*Weber's catseye* *Cryptantha weberi*	This species is known from a single observation in 2005.	Climate change vulnerability assessments for areas surrounding the Forest indicate that the alpine habitat of this species is considered to be highly vulnerable to negative impacts from changes in temperature and precipitation regimes in southwest Colorado and this species is thus threatened by the loss of its alpine habitat. Small and Isolated populations are susceptible to threats from genetic drift and stochastic events. Species with single occurrences have particular viability concerns because a single event can remove the species entirely.
Plants	*Weber's catseye* *Cryptantha weberi*	Known from 3 locations, the most recent observation in1998.	This species is documented to be negatively impacted by domestic livestock grazing.
Plants	*Slender rock-brake* *Cryptogramma stelleri*	Known from a single occurrence. Last observation in 1988.	This species is found in spruce-fir habitat which has undergone a 90 percent mortality event resulting in a loss or alteration of this species' habitat. Aerial imagery from 2016 indicates that the canopy cover of spruce at the single occurrence of this species has been lost. Climate change vulnerability assessments for areas surrounding the Forest indicate that this species is extremely vulnerable to negative impacts from changes in temperature and precipitation regimes that may alter the cool moist dripping spring cliff habitat of this species. There are dispersal and migratory barriers for this species. Small and isolated populations are susceptible to threats from genetic drift and stochastic events. Species with single occurrences have particular viability concerns because a single event can remove the species entirely.
Plants	Mountain bladder fern *Cystopteris montana*	Known from a single occurrence. Last observation in 1986.	This species is found in spruce-fir habitat which has undergone a 90 percent mortality event resulting in a loss or alteration of this species' habitat. Aerial imagery from 2016 indicates that the canopy cover of spruce at the single occurrence of this species has been lost. Climate change vulnerability assessments for areas surrounding the Forest indicate that the spruce-fir habitat of this species is moderately threatened by changes in temperature and precipitation regimes. Small and isolated populations are susceptible to threats from genetic drift and stochastic events. Species with single occurrences have particular viability concerns because a single event can remove the species entirely.

Category	Species	Evidence of Occurrence	Substantial Concern About the Species Capability to Persist over the Long Term
Plants	Colorado larkspur *Delphinium alpestre*	There are 3 known occurrences of this G2 species, the most recent being in 1998.	Vulnerability Assessments for areas surrounding the Forest assessed the alpine habitat of this species and determined that it is considered to be highly vulnerable to negative impacts from changes in temperature and precipitation regimes in southwest Colorado and this species is threatened by the loss of its alpine habitat. Small and Isolated populations are susceptible to threats from genetic drift and stochastic events. Since small and isolated population only occur in a certain area and have a smaller population they are more susceptible to loss.
Plants	*San Juan draba Draba graminea*	This G2 species is known from 3 locations and the most recent observation is from 2013.	Climate change vulnerability assessments for areas surrounding the Forest indicate that this species is extremely vulnerable to negative impacts from changes in temperature and precipitation regimes that may alter the alpine habitat of this species. The assessments indicate that the alpine habitat of this species is considered to be highly vulnerable to negative impacts from changes in temperature and precipitation regimes in southwest Colorado and this species is threatened by the loss of its alpine habitat. The species is reliant on ice and snow. There are dispersal and migratory barriers for this species. Small and isolated populations are susceptible to threats from genetic drift and stochastic events.
Plants	*Gray's draba Draba grayana*	This G2 species is known from 2 locations and the most recent observation is from 1985. Aerial imagery indicates that the alpine scree slope where this species was observed is unaltered and thus there is no evidence to assume the species is no longer present.	Climate change vulnerability assessments for areas surrounding the Forest indicate that the alpine habitat of this species is considered to be highly vulnerable to negative impacts from changes in temperature and precipitation regimes in southwest Colorado and this species is threatened by the loss of its alpine habitat. Additional threats to this species include recreation and mountain goats. The occurrences are small and isolated and are thus susceptible to threats from genetic drift and stochastic events.
Plants	Smith's draba *Draba smithii*	G2 Species. There are 12 occurrences the most recent observation was in 2002.	Climate change vulnerability assessments for areas surrounding the Forest indicate that the alpine habitat of this species is considered to be highly vulnerable to negative impacts from changes in temperature and precipitation regimes in southwest Colorado and this species is thus threatened by the loss of its alpine habitat. These assessments indicate that this species is extremely vulnerable to negative impacts from changes in seasonal precipitation as well as threats from energy development, its restriction to specific geologic substrates, dispersal barriers, and migration barriers. Small and isolated populations are susceptible to threats from genetic drift and stochastic events.

Category	Species	Evidence of Occurrence	Substantial Concern About the Species Capability to Persist over the Long Term
Plants	Colorado Divide whitlow-grass *Draba streptobrachia*	Species is known from 4 occurrences, the most recent observation is from 2002.	Climate change vulnerability assessments for areas surrounding the Forest indicate that the alpine habitat of this species is considered to be highly vulnerable to negative impacts from changes in temperature and precipitation regimes in southwest Colorado and this species is thus threatened by the loss of its alpine habitat. The species is reliant on ice and snow. There are dispersal and migratory barriers for this species. Small and isolated populations are susceptible to threats from genetic drift and stochastic events.
Plants	Philadelphia fleabane *Erigeron philadelphicus*	Known from a single observation in 1990. Aerial imagery indicates that the wet meadow habitat where this species was observed is unaltered and thus there is no evidence to assume the species is no longer present.	Climate change vulnerability assessments for areas surrounding the Forest indicate that the low elevation riparian and wetland habitat of this species is highly susceptible to changes in temperature and precipitation regimes. Small and isolated populations are susceptible to threats from genetic drift and stochastic events. Species with single occurrences have particular viability concerns because a single event can remove the species entirely.
Plants	Many-flowered gilia *Ipomopsis multiflora*	Known from a single occurrence in 1986. Analysis of aerial imagery indicates that the open woodland habitat of this occurrence is unaltered and thus there is no evidence to assume the species is no longer present.	The single occurrence of this species is threatened by invasive plant species and impacts from the management of those invaders. Small and isolated populations are susceptible to threats from stochastic events and genetic drift. Species with single occurrences have particular viability concerns because a single event can remove the species entirely.
Plants	Spiny-spored quillwort *Isoetes tenella*	Known from 4 occurrences. The most recent was from 2000.	This species and its aquatic and fen habitat are threatened by alterations in flow from development and diversion. Similarly, climate change vulnerability assessments for areas surrounding the Forest indicate that the aquatic and fen habitat of this species is moderately vulnerable to changes in temperature and precipitation regimes. The occurrences of this species on the Forest are small and isolated which are susceptible to threats from genetic drift and stochastic events.
Plants	Colorado woodrush *Luzula subcapitata*	Known from 3 occurrences, the most recent in 2004.	Climate change vulnerability assessments for areas surrounding the Forest indicate that this species and its fen habitat are extremely vulnerable to negative impacts from changes in temperature and precipitation. This species lives on the margins of fens and riparian habitats which are susceptible to negative impacts from small changes in hydrology. The occurrences are small and isolated which are susceptible to threats from genetic drift and stochastic events

Category	Species	Evidence of Occurrence	Substantial Concern About the Species Capability to Persist over the Long Term
Plants	Colorado tansy aster *Machaeranthera coloradoensis*	Known from 4 occurrences. The most recent was from 1997.	Threats include recreation and road construction/maintenance, pipeline construction, and construction of radio towers.
Plants	House's sandwort *Minuartia macrantha*	Species was collected in 2003. The single occurrence was from alpine habitat just east of Stony Pass.	Climate change vulnerability assessments for areas surrounding the Forest indicate that this species is extremely vulnerable to negative impacts from changes in temperature and precipitation regimes. These assessments indicate that the alpine habitat of this species is considered to be highly vulnerable to negative impacts from changes in temperature and precipitation regimes in southwest Colorado and thus this species is threatened by the loss of its alpine habitat. Small and isolated populations are susceptible to genetic drift and loss from stochastic events. Species with single occurrences have particular viability concerns because a single event can remove the species entirely.
Plants	Parry's crazy-weed *Oxytropis parryi*	Species was collected in 1998 and 1999, on rocky slopes north of Saguache and at the head of Raspberry Canyon.	Climate change vulnerability assessments for areas surrounding the Forest indicate that the alpine habitat of this species is considered to be highly vulnerable to negative impacts from changes in temperature and precipitation regimes in southwest Colorado and this species is thus threatened by the loss of its alpine habitat. Small and isolated populations are susceptible to negative impacts from genetic drift and stochastic events.
Plants	Southern Rocky Mountain cinquefoil *Potentilla ambigens*	There are 3 occurrences of this species, the most recent observation is from 1998.	Threats to the species include recreation and trail use. Occurrences are less than 100 individuals. Small populations are susceptible to negative impacts from stochastic events, particularly species like this one that live close to rivers, streams, trails, and roads where these events are more likely.
Plants	Arizona willow *Salix arizonica*	G2 species found in a single location. Species was observed to be extant in 2016.	The single occurrence is documented to be threatened by livestock grazing, wildlife damage, and recreation. Climate change vulnerability assessments for areas surrounding the Forest indicate that the high elevation fen habitat of this species is also threatened by changes in temperature and precipitation resulting in changes in the hydrology. The single occurrence of Arizona willow is isolated from other occurrences of the species. Isolated populations are subject to negative impacts from genetic drift. Species with single occurrences have particular viability concerns because a single event can remove the species entirely.
Plants	Tundra saxifrage *Saxifraga caespitosa* ssp. *monticola*	Known from a single occurrence. Documented in 1998.	Climate change vulnerability assessments for areas surrounding the Forest indicate that the alpine habitat of this species is considered to be highly vulnerable to negative impacts from changes in temperature and precipitation regimes in southwest Colorado and this species is thus threatened by the loss of its alpine habitat. The occurrence is isolated from other populations of this species. Isolated populations are susceptible to negative impacts from genetic drift. Species with single occurrences have particular viability concerns because a single event can remove the species.

Category	Species	Evidence of Occurrence	Substantial Concern About the Species Capability to Persist over the Long Term
Plants	King's campion *Silene kingii*	G2 species known from a single occurrence, documented in 2005.	Climate change vulnerability assessments for areas surrounding the Forest indicate that the alpine habitat of this species is considered to be highly vulnerable to negative impacts from changes in temperature and precipitation regimes in southwest Colorado and thus this species is threatened by the loss of its alpine habitat. The occurrence is isolated from other populations of this species. Isolated populations are susceptible to negative impacts from genetic drift. Species with single occurrences have particular viability concerns because a single event can remove the species entirely.
Plants	Fine bog-moss *Sphagnum angustifolium*	There is a single occurrence along Iron Creek in 2016.	Climate change vulnerability assessments for areas surrounding the Forest indicate that this species and its high elevation fen habitat are threatened by changes in temperature and precipitation regimes. The population is small and isolated, and small and isolated populations are subject to threats from genetic drift and stochastic events. Species with single occurrences have particular viability concerns because a single event can remove the species.
Plants	Rothrock townsend-daisy *Townsendia rothrockii*	G2 species known from 3 occurrences. The species was known to be extant in 2016.	Climate change vulnerability assessments for areas surrounding the Forest indicate that this species is extremely vulnerable to negative impacts from changes in temperature and precipitation regimes, particularly because it is dependent on ice and snow. These assessments indicate that the alpine habitat of this species is considered to be highly vulnerable to negative impacts from changes in temperature and precipitation regimes in southwest Colorado and this species is thus threatened by the loss of its alpine habitat. Additionally, the occurrences are small and isolated. Small and isolated populations are subject to threats from genetic drift and stochastic events.

Species that were considered during the development of the species of conservation concern list are contained in Table 122. The rationale for not including these species is included.

Table 122. Species considered early but after further review were not identified as species of conservation concern

Category	Species	Evidence of Occurrence	Rationale for not including the species as Draft SCC
Amphibian	Leopard frog *Rana pipiens*	Not known to occur	Locally this is primarily a lower-elevation species. Limited, but historical occurrence on Forest. No known existing populations or occurrences.
Bird	Grasshopper sparrow *Ammodramus savannarum*	Not known to occur	Very limited occurrence in select locations in the San Luis Valley. Very limited, if any, potential habitat on Forest.
Bird	Sage sparrow *Amphispiza belli*	Known to occur	Limited suitable habitat on the Forest and most occurrence records are peripheral, with only one documented occurrence in 2004. Very limited ability to influence species through management actions.
Bird	Golden eagle *Aquila chrysaetos*	Known to occur	Associated with primarily low-elevation open grasslands with rocky outcrops. Appears to be secure, occupying these habitats where expected, and, in some cases, at relatively high densities (up to seven nesting eagles at locations). Also continues to enjoy protections under the Bald and Golden Eagle Protection Act.
Bird	Burrowing owl *Athene cunicularia*	Not known to occur	No occurrence on Forest documented through continuous survey efforts, including high-use areas such as prairie dog colonies.
Bird	Juniper titmouse *Baeolophus griseus*	Known to occur	Global and state rankings suggest species is secure globally and locally. No known substantial conservation concern.
Bird	Ferruginous hawk *Buteo regalis*	Not known to occur	Limited nesting occurrences are restricted to the valley floor. Very little if any potential habitat.
Bird	Cassin's finch *Carpodacus cassinii*	Known to occur	Global and state rankings suggest species is secure globally and locally. No known substantial conservation concern.
Bird	Veery *Catharus fuscescens*	Known to occur	No reported occurrences under existing databases. Potential evidence of recent breeding at one location. Presence is considered peripheral.
Bird	Mountain plover *Charadrius montanus*	Not known to occur	No occurrence documented through continuous survey efforts, including high-use areas such as prairie dog colonies.
Bird	Northern harrier *Circus cyaneus*	Not known to occur	Nesting habitat and occurrences primarily restricted to the valley floor. The Forest has little potential habitat.
Bird	Black swift *Cypseloides niger*	Known to occur	Survey efforts suggest the population is stable and secure statewide and locally. No documented connection or concerns about effects of Forest uses and management as primary risk factors. Unique species that may warrant other occasional monitoring efforts.

Category	Species	Evidence of Occurrence	Rationale for not including the species as Draft SCC
Bird	Prairie falcon *Falco mexicanus*	Known to occur	No known substantial conservation concern. Distribution is widespread and rangewide populations are thought to be stable. Cliff and outcrop breeding habitat is unchanged and secure.
Bird	Pinyon jay *Gymnorhinus cyanocephalus*	Known to occur	No known substantial conservation concern. Limited management activity in available habitat. Global and state rankings suggest the species is secure.
Bird	Bald eagle Haliaeetus leucocephalus	Known to occur	No breeding or wintering confirmed and no clear evidence of concern for persistence. Species continues to enjoy important protections under the Bald and Golden Eagle Protection Act.
Bird	Loggerhead shrike *Lanius ludovicianus*	Known to occur	Occurrence is peripheral. Very few documented occurrences. Very little suitable habitat.
Bird	Virginia's warbler *Leiothlypis virginiae*	Known to occur	Fairly common to abundant nesting inhabitant in western Colorado, limited occurrences. Global and state ranking suggest the species is secure. High dispersal capability. Shrubland habitats are limited in availability and stable on the forest, no known substantial conservation concern.
Bird	Brown-capped rosy finch *Leucosticte australis*	Known to occur	Breeding habitat consists of cliffs, caves, and rock crevices in alpine and tundra habitats that is stable and secure. Some uncertainty about sensitivity of alpine habitat to changes to precipitation and temperature regimes. The species is fairly common. No known substantial conservation concern.
Bird	Lewis's woodpecker *Melanerpes lewis*	Known to occur	Occurrence is peripheral and primarily associated with lower elevation cottonwood systems such as those along the Alamosa and Conejos River drainages. There are very few documented Forest observations over the past 20 years. Very little suitable habitat.
Bird	Band-tailed pigeon *Patagioenas fasciata*	Known to occur	Migratory species. Occurrence is sporadic and seasonal with no known nesting occurrence.
Invertebrate	Monarch butterfly *Danaus plexippus*	Not known to occur	Limited available habitat.
Invertebrate	Theano alpine *Erebia pawloskii*	Not known to occur	Globally secure, moderate concern statewide. Not known to occur.
Invertebrate	Colorado blue (butterfly) *Euphilotes rita coloradensis*	Not known to occur	Lower elevation, prairie species. Very limited habitat.
Invertebrate	Alberta Arctic *Oeneis alberta*	Known to occur	There are no records of this species occurrence. Bunchgrass habitat Forestwide is not at risk.

Category	Species	Evidence of Occurrence	Rationale for not including the species as Draft SCC
Invertebrate	Gold-edge gem moth *Schinia avemensis*	Not known to occur	Lower elevation species, limited habitat.
Invertebrate	Great Basin silverspot *Speyeria nokomis nokomis*	Not known to occur	Lower elevation species, limited habitat.
Mammal	Hoary bat *Lasiurus cinereus*	Known to occur	Individuals detected locally during acoustic bat surveys. Forest occupancy is limited with a 5 occurrences reported over the past 20 years. Potential habitat loss a concern due to the loss of spruce habitat due to the impacts of spruce beetle. Abundant aspen forest remains unaffected and available. Windfarms are a primary threat, but none occur or are planned.
Mammal	Southern red-backed vole *Myodes gapperi*	Known to occur	Global and state rankings suggest species is secure in Colorado and locally. No known substantial conservation concern.
Mammal	Little brown bat *Myotis lucifugus*	Known to occur	Has experience substantial population declines in eastern and Midwestern states affected by white-nose syndrome. White nose syndrome has not yet occurred in Colorado nor the Forest; therefore, there is currently no known substantial conservation concern. Plan components address regarding abandoned mine features for bat species prior to closure.
Mammal	Big free-tailed bat *Nyctinomops macrotis*	Known to occur	Occurrence is peripheral. Very few documented occurrences, no known breeding or roosting areas on. Very little suitable habitat.
Mammal	American pika *Ochotona princeps*	Known to occur	In Colorado, species remains common in available talus habitat. Quantity of talus habitats remains stable. May be some concerns for effects of changes in temperature and precipitation regimes to alpine habitats but uncertain at this time. No known substantial conservation concern locally although occasional monitoring may be warranted.

Mammals	Rocky mountain bighorn sheep *Ovis canadensis canadensis*	Known to occur	In western North America bighorn sheep populations have declined from an estimated 500,000 at the onset of European settlement to an estimated 15,000 to 20,000 by 1960. Numbers have increased since 1960 due to population translocations and augmentations and other conservation efforts. The distribution of bighorn sheep is naturally fragmented due to the patchy nature of preferred habitats, and bighorn sheep typically make seasonal movements to alpine habitats in summer and lower elevation habitats or south-facing slopes during the winter period. The primary risk to persistence on the planning unit is transmission of novel pathogens from domestic sheep to bighorn sheep, and subsequent disease outbreaks and population impacts. Current and expected future domestic sheep grazing on the Forest includes some risk of contact between domestic sheep and bighorn sheep, and such contact can result in respiratory disease outbreaks in bighorn sheep. Respiratory disease in bighorn sheep can result in all age die-offs which can have lasting impacts on populations through suppressed lamb recruitment following disease outbreaks. In-breeding, loss of alpine habitat due to changing temperature and precipitation patterns, and unintentional human harassment can also represent added stressors further impacting viability of local herds and populations. Despite the risks to bighorn sheep from domestic sheep, Forest bighorn sheep populations have persisted for the past several decades. Colorado Parks and Wildlife has identified 12 Game Management Units (akin to herds) that occur entirely or in part on the Forest. Several herds cross administrative boundaries and occur on adjacent public or private lands during part of their life cycles. Overall population estimates for the 12 herds total approximately 1,100 individuals, and the total population estimates have fluctuated from approximately 1,000 to 1,500 animals during the past 30 years. Population die-offs due to disease have been observed or suspected in several herds during this time, and some herds have been augmented via population translocations. Currently, several bighorn sheep herds are still recovering from die-off events in the 1990's. The presence of some type of respiratory pathogen has been confirmed in 8 herds. Most herds are currently hunted with regulations and population objectives established by Colorado Parks and Wildlife. Among the herds whose Game Management Unit boundaries overlap the Forest, 3 occur in areas where domestic sheep grazing is not currently permitted and is not anticipated in the foreseeable future. These herds (S08, S09, and S68, though S68 includes only a small portion of the Forest) occur in the Sangre de Cristo mountains on the eastern Forest boundary and account for an estimated 40 percent of the overall Forestwide bighorn sheep population. While long-distance movements from other herds could potentially move pathogens into these herds, this is a relatively low likelihood concern and these herds are considered secure based on management actions under Forest authority. Other herds are at some risk of contact with domestic sheep and transmission of pathogens is possible. Despite the risk to herds outside the Sangre de Cristo mountains, bighorn sheep are likely to persist Forestwide due to the strongholds in the Sangre de

Category	Species	Evidence of Occurrence	Rationale for not including the species as Draft SCC
			Cristo mountains and the absence of the domestic sheep grazing, the main threat to persistence. Population management by Colorado Parks and Wildlife will contribute to the persistence of bighorn sheep through establishing population objectives, managing hunting opportunities and potentially through population augmentation via translocations. Lastly, through collaborative monitoring with Colorado Parks and Wildlife and other partners will help provide information on the effectiveness of management actions and help identify potential changes in management needed to support the persistence of bighorn sheep.
Mammal	Abert's squirrel *Sciurus aberti*	Known to occur	Widespread through the ponderosa pine zone. No known substantial conservation concern.
Mammal	Dwarf shrew *Sorex nanus*	Not known to occur	No occurrences or known habitat.
Mammal	Botta's pocket gopher *Thomomys bottae pervagus*	Not known to occur	Species considered secure locally. Limited available habitat.
Plant	Rydberg's golden columbine *Aquilegia chrysantha var. rydbergii*	Not known to occur	
Plant	Vierhapper's/Alpine aster *Aster alpinus var. vierhapperi*	Known to occur	Too long a time has passed since observation for species to be known to occur.
Plant	Violet milkvetch *Astragalus iodopetalus*	Not known to occur	
Plant	Missouri milkvetch *Astragalus missouriensis var. humistratus*	Not known to occur	
Plant	Aztec milkvetch *Astragalus proximus*	Not known to occur	
Plant	Crandall's rockcress *Boechera crandallii*	Not known to occur	
Plant	Narrowleaf grapefern *Botrychium lineare*	Not known to occur	

Category	Species	Evidence of Occurrence	Rationale for not including the species as Draft SCC
Plant	Winding mariposa lily *Calochortus flexuosus*	Not known to occur	
Plant	Lesser tussock sedge *Carex diandra*	Not known to occur	
Plant	Mud sedge *Carex limosa*	Known to occur	Too long a time has passed since observation for species to be known to occur.
Plant	Slender spiderflower *Cleome multicaulis*	Not known to occur	
Plant	James' cryptantha *Cryptantha cinerea*	Known to occur	Taxonomists lumped this species together with a more widespread, stable species. No conservation concern for the larger species.
Plant	Lesser yellow lady's – slipper *Cypripedium parviflorum*	Not known to occur	
Plant	Wahatoya larkspur *Delphinium robustum*	Not known to occur	
Plant	Heil's tansy mustard *Descurainia kenheilii*	Not known to occur	
Plant	Stream orchid, giant helleborine *Epipactis gigantea*	Not known to occur	
Plant	Brandegee's buckwheat *Eriogonum brandegeei*	Not known to occur	
Plant	Colorado wild buckwheat *Eriogonum coloradense*	Not known to occur	
Plant	Whitebristle cottongrass *Eriophorum altaicum var. neogaeum*	Known to occur	Removed from Regional Forester Sensitive Species list due to taxonomic lumping. Good viability.
Plant	Chamisso's cottongrass *Eriophorum chamissonis*	Not known to occur	
Plant	Slender cottongrass *Eriophorum gracile*	Not known to occur	

Category	Species	Evidence of Occurrence	Rationale for not including the species as Draft SCC
Plant	Bill's neoparrya *Neoparrya lithophila*	Known to occur	Present, no conservation concern due to stable populations that are largely free of threats.
Plant	Kotzebue's grass of Parnassus *Parnassia kotzebuei*	Not known to occur	
Plant	Degener's beardtongue *Penstemon degeneri*	Not known to occur	
Plant	Ice cold buttercup *Ranunculus karelinii*	Known to occur	Taxonomy issues make it difficult to judge the rarity of the species, as taxonomists are uncertain if this is a distinct species or part of a large, more common species. No state ranking because of taxonomic dispute.
Plant	Sageleaf willow *Salix candida*	Not known to occur	
Plant	Autumn willow *Salix serissima*	Not known to occur	
Plant	Weber's saw-wort *Saussurea weberi*	Not known to occur	
Plant	Pale blue-eyed grass *Sisyrinchium pallidum*	Not known to occur	
Plant	Baltic sphagnum *Sphagnum balticum*	Not known to occur	
Plant	Smooth Easter daisy *Townsendia glabella*	Not known to occur	
Plant	Lesser bladderwort *Utricularia minor*	Not known to occur	
Plant	New Mexico cliff fern *Woodsia neomexicana*	Known to occur	Occurrences are small and isolated and small and isolated populations are susceptible to negative impacts from genetic drift and stochastic events. However, this is not enough to substantiate a local concern for continued persistence.
Plant	Plummer's cliff fern *Woodsia plummerae*	Known to occur	Occurrences are small and isolated and small and isolated populations are susceptible to negative impacts from genetic drift and stochastic events. However, this is not enough to substantiate a local concern for continued persistence.

References Cited

Cameron, S.A., Lozier, J.D., Strange, J.P., Koch, J.B., Cordes, N., Solter, L.F., and Griswold, T.L. 2010. Patterns of widespread decline in North American bumble bees. Proceedings of the National Academy of Sciences of the United States of America 108(2):662–667. Accessed August 16, 2017, at: http://www.pnas.org/content/108/2/662

Sauer, J.R., J.E. Hines, J.E. Fallon, K.L. Pardieck, D.J. Ziolkowski, Jr., and W.A. Link. 2011. The North American breeding bird survey, results and analysis 1966–2009. Version 3.23.2011 U.S. Geological Survey Patuxent Wildlife Research Center, Laurel, Maryland. Accessed August 16, 2017, at: https://www.nrc.gov/docs/ML1127/ML112760805.pdf

United States Department of Agriculture
Forest Service

Rio Grande National Forest
1803 W. Highway 160
Monte Vista, CO 81144
www.fs.usda.gov/main/riogrande/