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Draft Environmental Impact Statement

Spruce Beetle Epidemic and Aspen Decline Management Response

Grand Mesa, Uncompahgre, and Gunnison National Forests

Delta, Garfield, Gunnison, Hinsdale, Mesa, Montrose, Ouray, Saguache, and San Miguel Counties, Colorado

Commonly Used Acronyms and Abbreviations

BA - Basal Area
BF - Board Foot
BMP - Best Management Practices
CCF - Cubic Hundred Feet
CEQ - Council on Environmental Quality
CF - Cubic Feet
CFR - Code of Federal Regulations
CMAI - Culmination of Mean Annual Increment
CWD - Coarse Woody Debris
DBH - Diameter Breast Height
DEIS - Draft Environmental Impact Statement
EIS - Environmental Impact Statement
EPA - Environmental Protection Agency
ESA – Endangered Species Act
FEIS - Final Environmental Impact Statement
FRCC - Fire Regime Condition Class
FS - Forest Service
FSH - Forest Service Handbook
FSM - Forest Service Manual
GHG - Greenhouse Gas
GIS - Geographic Information System
GPS - Global Positioning System
IDT - Interdisciplinary Team
MA - Management Area
MBF - Thousand Board Feet
MIS - Management Indicator Species
MMBF - Million Board Feet
MVUM - Motorized Vehicle Use Map
NEPA - National Environmental Policy Act
NFMA - National Forest Management Act
NFS - National Forest System
NFSR - National Forest System Road
OHV - Off Highway Vehicle
ROD - Record of Decision
SAD - Sudden Aspen Decline
SBEADMR – Spruce Beetle Epidemic and Aspen Decline Management Response
S&G - Standard(s) and Guideline(s)
SHPO - State Historic Preservation Officer
T&E - Threatened and Endangered
TMP - Travel Management Plan
TSI - Timber Stand Improvement
USDA - United States Department of Agriculture
USFWS - United States Fish and Wildlife Service
WUI - Wildland-Urban Interface

SPRUCE BEETLE EPIDEMIC AND ASPEN DECLINE MANAGEMENT RESPONSE

Draft Environmental Impact Statement

Delta County, Colorado

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Abstract: The Grand Mesa, Uncompahgre, and Gunnison National Forests (GMUG) have prepared a Draft Environmental Impact Statement (EIS) in compliance with the National Environmental Policy Act (NEPA) and other relevant Federal and State laws and regulations. Due to the ongoing spruce beetle epidemic and sudden aspen decline that is occurring across a broad landscape on the GMUG Forests, the GMUG proposes the Spruce Beetle Epidemic and Aspen Decline Management Response (SBEADMR) to adaptively implement vegetation management actions, informed by the Western Bark Beetle Strategy (2011i) and guided by the GMUG National Forest Land and Resource Management Plan (Forest Plan) and other national-level policy and guidance. The focus of the proposed action is to actively manage spruce-fir and aspen vegetation to reduce hazards to the public and infrastructure, salvage dead and dying timber, reestablish forest cover and increase resiliency in green stands. Alternative 1 is the No Action Alternative. This alternative is used as a basis for comparing the effects of the Proposed Action and other alternatives. It assumes no implementation of any elements of the proposed action or other action alternatives. Alternative 2 is the Proposed Action. This alternative uses an adaptive implementation approach to implement vegetation management activities across the landscape. Spruce stands with lower mortality would be partially harvested using uneven-aged management to increase spruce-fir resiliency. Both live green trees and pockets of dead and dying trees would be removed. In areas with higher overstory mortality, the amount of salvage harvest would increase. Aspen stands affected by sudden aspen decline would be prioritized for treatment with coppice cuts and/or prescribed fire, though selected aspen stands not currently affected would also be treated to increase resiliency. Alternative 3 focuses on human health and safety, and limits treatments to lands within the designated wildland-urban interface (WUI) boundary and roadside corridors. Alternative 4 limits spruce-fir treatments to salvage only. Spruce-fir stands that have been affected by spruce bark beetle would be treated for recovery purposes, limiting treatments to dead and dying trees; aspen treatments would be the same as in Alternative 2. At this stage in the planning process, the deciding official has not selected a preferred alternative. This draft EIS

discloses the direct, indirect, and cumulative environmental impacts resulting from the proposed action and alternatives.

Submit electronic comments to:	**http://www.fs.usda.gov/goto/SBEADMR_comments**
Submit hardcopy comments to:	**Scott Armentrout, Forest Supervisor** **Attn: SBEADMR** **Mailing address: 2250 Highway 50, Delta, CO 81416** **Fax: 970-874-6698**

Opportunity to comment on the Draft EIS ends 45 days following the publication date of the Notice of Availability of the draft environmental impact statement in the *Federal Register*.

SUMMARY

The Grand Mesa, Uncompahgre, and Gunnison National Forests (GMUG) propose to implement multiple vegetation management actions within the Spruce Beetle Epidemic and Aspen Decline Management Response (SBEADMR) project. This proposal is guided by the Ecological Restoration and Resilience Policy (FSM 2020), the GMUG National Forest Land and Resource Management Plan (Forest Plan), and is adapted from the Western Bark Beetle Strategy (2011i).

The SBEADMR project proposes to treat spruce and aspen forests impacted by the ongoing spruce beetle epidemic and by sudden aspen decline (SAD), as well as those areas that are considered high risk for spruce beetle or SAD across the GMUG National Forests. The GMUG contains approximately 223,000 cumulative acres of spruce beetle mortality and 229,000 acres of affected aspen accumulated over the past decade, which corresponds to approximately 30% of the spruce-fir and aspen vegetation on the Forests. While insects and disease naturally occur in these ecosystems, prolonged drought and unusually high temperatures have exacerbated these disturbances. The rate of change in tree mortality is extensive, and both the bark beetle infestation and SAD outbreak are likely to continue for several more years. The implications of these continued conditions include increased risk to the public and infrastructure from hazard trees, high mortality in spruce-dominated stands, decline of aspen stands, and changes in plant community and vegetation structure over time. Given the substantial mortality of spruce-fir and aspen forests on the GMUG over the past decade, and current Forest Plan direction, the need for the project is to manage forest vegetation to bring current and foreseeable conditions closer to desired conditions on landscapes available for active management. Furthermore, in the context of a changing climate conducive to more frequent and extensive wildfires in forests at high elevation irrespective of tree condition (Westerling et al. 2006, Agee 2007; Funk 2012; Rangwala and Rondeau), desired conditions for fire and fuels management include more locations across the landscape from which firefighters can safely and effectively manage or suppress fires for values at risk and/or resource benefit.

The purpose of the project is to reduce the safety threats of falling, dead trees and of managing wildfires in affected stands; treat affected stands via recovery of salvageable timber and subsequent re-establishment of desired forest conditions; and improve the resiliency of stands at-risk of insect and disease. In spruce stands, improved resiliency would be achieved via increasing diversity of age class and tree species and by reducing stand density. In aspen stands, younger trees are often more resilient to SAD, so resiliency treatments there would focus on removing aspen and regenerating the stand.

A maximum of 120,000 acres of National Forest System (NFS) lands within the GMUG are analyzed under each action alternative in this DEIS for treatments over an approximately 8-12 year implementation timeframe.

Comments on the proposed action, potential concerns, and opportunities for managing the SBEADMR project were solicited through varied public involvement and collaboration efforts. Those solicited for input included Forest Service resource specialists, tribal representatives, members of the public, other public agencies, adjacent property owners, and organizations. Methods used to request comments included: Publishing a Notice of Intent (NOI) in the Federal Register to prepare this Environmental Impact Statement (EIS); mailing a scoping letter that solicited comments to approximately 1,300 interested parties; conducting public meetings; and meetings with interested parties and individuals.

Comments received during scoping were used to help define issues, develop alternatives and mitigation measures, and analyze effects. Through review and analysis of the scoping comments, the Interdisciplinary Team (IDT) identified four substantial issues: (1) impacts from roads, (2) efficacy of resiliency treatments, (3) socioeconomic impacts to local communities, and (4) restricting treatments to address only public safety.

A number of alternatives, or features common to all alternatives, were developed to address these issues. At this stage in the planning process, the deciding official has not selected a preferred alternative. The alternatives analyzed in detail in this EIS are briefly described as follows:

Alternative 1: No Action – The National Environmental Policy Act (NEPA) requires the study of the No Action Alternative and to use it as a basis for comparing the effects of the Proposed Action and other alternatives. This alternative assumes no implementation of the proposed action or any of the alternatives within the project area. Vegetation management would not take place unless authorized by other decisions. Vegetation structure would change over time through natural growth and mortality and events such as wildfires, storms, and insect or disease outbreaks. Under the No Action alternative, current management plans would continue to guide management of the project area. Routine activities not tied to this analysis such as scheduled road maintenance, treatment of noxious weeds, and fire suppression would also continue.

Actions Common to All Action Alternatives

Each action alternative proposed adaptive management implementation of a suite of treatments to address the effects of the spruce beetle epidemic and sudden aspen decline and promote resiliency to future insect outbreaks and disease.

Treatment methods used would consist of: 1) commercial mechanical treatment, which is ground-based mechanized timber cutting on lands suitable for timber harvest that produces a commercial product, 2) non-commercial mechanical treatment, which is ground-based mechanized timber cutting that does not produce a commercial product, and includes use of mechanized equipment for tree cutting, mastication, and hand treatments using chainsaws; and 3) prescribed burning, which includes broadcast burning and pile burning. Each action alternative would use existing roads where possible

and include some amount of road construction; most new roads would be decommissioned following project implementation.

The total acres analyzed for treatment is the same for each action alternative, with 70,000-120,000 acres analyzed for treatment across the life of this project. Approximately 4,000-6,000 acres of commercial harvest would be treated annually, and approximately 3,000-6,000 acres of non-commercial mechanical or prescribed burning treatments would be treated annually over the life of the project. This treatment area is a subset of the total *opportunity area* analyzed; opportunity areas differ by action alternative, in accordance with different management emphases.

Public collaboration beyond the basic requirements of the NEPA process is a critical aspect of all action alternatives, and it is integrated into the adaptive implementation strategy.

Alternative 2: Proposed Action – The total Alternative 2 opportunity area is 718,000 acres where commercial, non-commercial mechanical and prescribed fire treatments could be implemented. Treatments could occur anywhere in spruce, aspen, and spruce/aspen mix vegetation types on the GMUG within this opportunity area. This is the maximum extent of opportunity area for Alternative 2, yet opportunities for commercial and non-commercial treatment have distinct spatial parameters within this opportunity area. Commercial treatments on suitable timber production areas would be largely limited to the identified 24 focus Lynx Analysis Units (LAUs), comprising an area of 278,000 acres; public safety treatments alongside roads may occur outside such LAUs. Approximately 80 percent of the suitable timber harvest areas within spruce vegetation on the Forest are contained in these 24 LAU, making this a cost-effective area to analyze and commercially treat. These LAUs also contain spruce stands with the highest level of current beetle activity or areas anticipated to be affected in the foreseeable future. Non-commercial treatments would be primarily focused outside suitable lynx habitat across the extent of the total opportunity area, with the exception of hazard tree treatments proximal to infrastructure and fuel treatments within 200 feet of infrastructure.

Alternative 3: Public Safety Focus – Alternative 3 shifts the geographic extent of treatments exclusively to 1) the wildland urban interface (WUI) and 2) outside the WUI, proximal to roads and additional human infrastructure. This alternative was developed to address public comments that proposed that treatments focus on public safety purposes.

The total Alternative 3 opportunity area covers 426,000 acres. Opportunities for commercial treatments would be limited to the 164,000 acres of suitable timber in this opportunity area.

All treatment types and methods would remain the same as in Alternative 2.

Alternative 4: Spruce Salvage – Alternative 4 limits spruce treatments to salvage only; aspen treatments would be the same as in Alternative 2. Spruce stands that have been affected by spruce bark beetle would be treated only for recovery purposes, limiting spruce treatments to dead and dying trees. Treatments would occur in the same geographic areas as Alternative 2 (718,000 acres total opportunity area), except commercial mechanical treatments would also occur in areas outside the 24

identified focus LAUs on suitable timber lands in aspen, spruce or aspen/spruce mix, resulting in an additional 50,000 acres available for commercial treatment opportunities relative to Alternative 2. Opportunities for commercial treatments would be limited to the 323,000 acres of suitable timber within the total opportunity area.

Chapter 1 of this EIS identifies the purpose and need for the proposed actions as well as related National and Forest-level policy and direction. Given this purpose and need, the Deciding Official (Forest Supervisor) reviews the project record and analysis, the proposed action, issues identified during scoping, the alternatives, and the environmental consequences of implementing the proposed action and alternatives disclosed in this EIS. This forms the basis for the Deciding Official to make the following determinations:

- Whether or not the proposed actions and alternatives address the issues, are responsive to National policy/guidance/law and Forest Plan direction, and meet the purpose of and need for action described in the SBEADMR EIS;
- Whether or not the information in this analysis is sufficient to implement the proposed activities;
- Which actions, if any, to approve.

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CHAPTER 1. PURPOSE AND NEED FOR ACTION

Document Structure

The Forest Service has prepared this Draft Environmental Impact Statement (DEIS) in compliance with the National Environmental Policy Act (NEPA) and other relevant Federal and State laws and regulations. This Environmental Impact Statement 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: The chapter includes information on the history of the project proposal, the purpose of and need for the project, and the agency's proposal for achieving that purpose and need. This section 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 agency's proposed action as well as alternative methods for achieving the stated purpose. These alternatives were developed based on significant issues raised by the public and other agencies. This discussion also includes mitigation measures. 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. This analysis is organized by resource area.

Chapter 4. Interdisciplinary Team Membership: This chapter provides a list of team members who participated to prepare this DEIS.

Appendices: The appendices provide more detailed descriptions of fundamental components of actions common to all alternatives.

Index: The index provides page numbers by topic.

Additional documentation, including more detailed analyses of project-area resources, may be found in the project planning record located at Grand Mesa, Uncompahgre, and Gunnison National Forests, 2250 Highway 50, Delta, CO 81416.

Background

The Grand Mesa, Uncompahgre, and Gunnison (GMUG) National Forests are located on the western slope of the Rockies and into the Colorado Plateau. Elevations of the 3,161,900 acre GMUG range from about 5,800 ft. (1,770 m) on the west foothills of Battlement Mesa, to over 14,200 ft. (4,330 m) on the high peaks of the San Juan and Saguache Mountains. All of the Grand Mesa, Uncompahgre, and Gunnison National Forests are on the western slope, as the Continental Divide forms the eastern and southeastern boundaries of the National Forests.

The GMUG includes diverse vegetation ranging from semi-desert, sagebrush, piñon-juniper, mountain shrublands, and ponderosa pine to lodgepole pine, Engelmann spruce, subalpine fir and quaking aspen to the alpine zone.

Annual precipitation on the GMUG ranges from about 10 inches (25.4 cm) per year in the bottom of the Gunnison Basin, to over 50 inches (127 cm) per year on the high peaks of the San Juan and Elk Mountains. Precipitation largely parallels elevation, with some notable exceptions in the rain shadows in the bottom of the Upper Gunnison Basin and the Cochetopa Hills area. Thus the higher precipitation areas are those associated by the higher mountain ranges – the Elk and West Elk Mountains, the San Juan Mountains, and the Grand and Battlement Mesas. The Cochetopa Hills and the Uncompahgre Plateau are on the low end of precipitation range for the Forests.

The GMUG has experienced approximately 223,000 cumulative acres of spruce beetle mortality and 229,000 acres of Sudden Aspen Decline accumulated over the past decade. Neighboring San Juan and Rio Grande National Forests have been experiencing a massive spruce beetle outbreak for the past decade. The spruce beetles have spilled over the Continental Divide into the GMUG. From 2013-2014, the cumulative acreage affected by spruce beetles increased by approximately 64,000 acres on the GMUG (pers.comm. Tom Eager). The landscape south and east of Gunnison, Colorado bordering the Rio Grande National Forest, is one of the highest spruce mortality areas on the GMUG. Mortality in spruce stands is expected to continue at relatively high levels for several years to come.

Similarly, aspen forests have been affected by Sudden Aspen Decline (SAD). SAD was first noticed in southwestern Colorado in 2004 (Worrall et al. 2008). On the San Juan National Forest, large and growing patches with of crown thinning, branch dieback, and mortality were found. It occurred on a landscape scale and rapidly increased in area and severity. Over the next few years, SAD spread to the GMUG and throughout Colorado. Approximately 33% (over 229,000 acres) of the GMUG's 712,000 acres of aspen vegetation was affected from 2000 to 2010. In 2009, the detection of new areas dropped considerably, and little new area has been mapped since then. However, stands currently exhibiting SAD continue to decline.

Furthermore, these disturbances are occurring in the context of a changing climate. Over the past 100 years, Southwestern Colorado temperatures have increased, and modeled climate projections for the region include warmer and longer frost-free summers, snowline moving up in elevation, earlier snowmelt, and consequently, a longer fire season.

Due to predicted warming, spruce beetle outbreaks could be more likely in the future. Higher summer temperatures can foster spruce beetle outbreaks by allowing beetles to reproduce every year rather than every two years (Bentz et al. 2010). Additionally, anticipated more frequent drought conditions place water-stressed stands at greater risk of insect and disease.

Climate changes could lead to larger fires and possibly fire with more high-severity area than in previous decades (Westerling et al. 2006, Agee 2007, Funk 2012). Modeled climate scenarios for the Gunnison Basin by 2035 indicate potential for the fire season to increase by one month; for fire frequency in high-elevation forests to increase from 4 to 12 times as often as experienced between 1971-2000; and for fire extent to increase from 6 to 11 times the extent burned between 1971-2000. These scenarios model severity and frequency irrespective of tree mortality (Rangwala and Rondeau, *Southwest Colorado Social-Ecological Climate Resilience (SECR) Project*).

The GMUG forest managers have developed the SBEADMR alternatives with the help of the public, partners, scientists and resource specialists to treat areas impacted by – and likely to be impacted by – insects and diseases in spruce and aspen forested ecotypes. The following sections contain a detailed description of the existing vegetation conditions in spruce-fir and aspen on the GMUG, the spruce beetle and SAD epidemics, and how changing climate impacts these species.

Spruce

Engelmann spruce (*Picea engelmannii*) is an important species in the Rockies. Engelmann spruce has value not only as timber, but also through the jobs and labor income connected to the harvesting of that value. The spruce-fir forests of the Rockies provide “shade and shelter that help to maintain the winter snow pack and prevent quick runoff during the spring melt and summer storms” (Western Bark Beetle Strategy). Additionally, spruce-fir forests provide recreational opportunities to hikers, hunters, mountain bikers, campers, four-wheelers and skiers as well as outstanding scenic views. Engelmann spruce and subalpine fir on the GMUG serves as valuable habitat for the Canada lynx, a federally listed endangered species, plus several other species which are either endangered, threatened or under consideration of being protected. Additionally, spruce-fir stands also provide habitat for the main prey species of lynx (snowshoe hares) and its secondary prey item, red squirrel.

A detailed description of existing vegetation types for the five geographic areas encompassing the GMUG are available in comprehensive assessments completed in 2006 (USDA Forest

Service, 2006e). Geographic areas (GA) are the Gunnison Basin, Uncompahgre Plateau, San Juan Mountains, Grand Mesa and the North Fork of the Gunnison River.

Habitat structural stages at the time of the assessment (2006) for spruce-fir for each geographic area are presented in Table 1. Data used to complete the assessment has had only minor adjustments since 2006. Overall, spruce-fir was dominated by mature and dense stand conditions (4B and 4C) across all GA. Where age data existed, most spruce-fir ranged in age from 100-200 years old. The highest percentage (>80%) of stands in a mature condition existed on the Grand Mesa, San Juan Mountains and the Uncompahgre Plateau. However, more than 50% of spruce-fir stands were in a mature condition for each of the GAs on the GMUG. Note that acres affected by beetles since 2006 are not reflected in this data. The following section, Spruce Beetlesand Spruce Mortality, concludes with a discussion of how the GMUG spruce beetle epidemic has shifted the habitat structural stages.

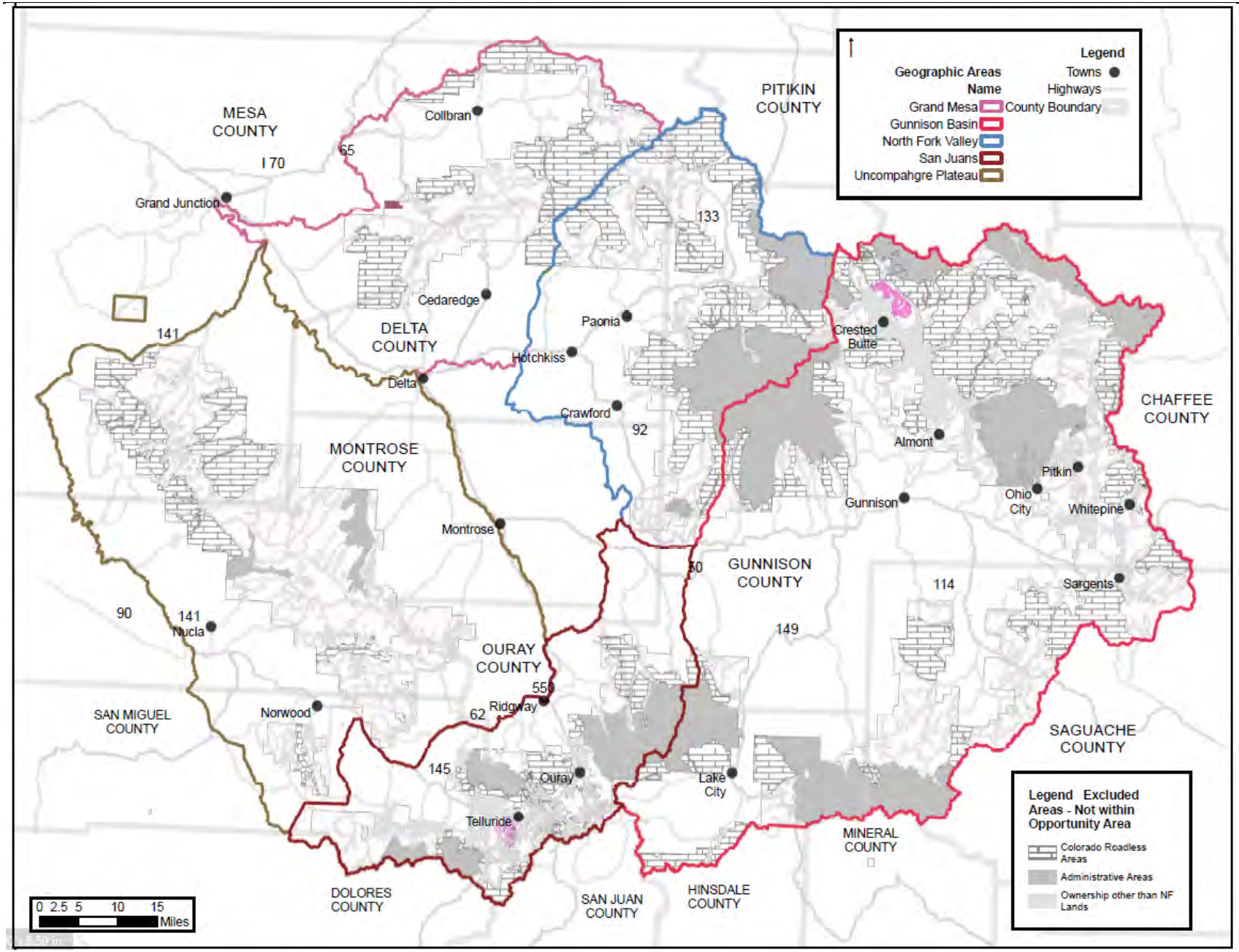

Figure 1. Geographic areas on the GMUG National Forest.

Table 1. Spruce-Fir Vegetation Characterization for the GMUG by Geographic Area, 2006.

GA	Cover Type	Composition of GA (% is of GA)	Age Distribution	Habitat Structural Stages[1]	Canopy Conditions
Gunnison Basin	Spruce-fir	354,300 acres (25%)	Most spruce-fir is between 120 to 200 years.	3A - 7% 3B – 20% 3C – 2% 4A- 10% 4B – 42% 4C – 19%	21% single-storied 79% multi-storied 98% continuous canopy
Grand Mesa	Spruce-fir	93,300 acres (26%) (58% without aspen in species mix, 42% with aspen in the species mix)	Ranges from 10 to 210 years. Most spruce-fir is between 100-160 yr. old	3A – 1% 3B – 5% 3C – 1% 4A – 7% 4B- 41% 4C- 46%	34% - single-storied 71% - multi-storied 97% - continuous canopies
San Juan Mountains	Spruce-fir	135,900 acres (36%)	Age data not available	3A -5% 3B- 4% 3C-<1% 4A- 10% 4B – 50% 4C- 31%	85% - single-storied 15% - multi-storied 79% - continuous canopies
North Fork Gunnison River	Spruce-fir	121,800 acres (23%)	Age data not available	3A – 5% 3B – 14% 3C – 2% 4A – 13% 4B – 38% 4C- 27%	28% - single-storied 72% - multi-storied 99% - continuous canopies
Uncompahgre Plateau	Spruce-fir	43,100 acres (7%)	Most spruce is between 80–140 yr. old Most subalpine fir is between 40-120 yr. old.	3A – 1% 3B- 7% 3C – 3% 4A – 4% 4B -47% 4C- 37%	54% - single-storied 46% - multi-storied 92% - continuous canopies

[1]Habitat Structural Stage	Size Class	Diameter	Crown Cover Percent
1T/1M	Grass-Forb	Not applicable	0 – 10%
2T/2S	Shrub-Seedling	< 1 inch	0 - 10%
3A	Sapling-Pole	1 – 9 inches	11 – 40%
3B	Sapling-Pole	1 – 9 inches	41 - 70%
3C	Sapling-Pole	1 – 9 inches	71 - 100%
4A	Mature	9+ inches	11 – 40%
4B*	Mature	9+ inches	41 - 70%
4C*	Mature	9+ inches	71 – 100%

**These structural stages are considered most susceptible to spruce beetle infestation.*

To evaluate how current conditions compare to historic ranges, the 2006 assessments on the GMUG used the Vegetation Dynamics Development Tool (VDDT). Current knowledge on disturbance intervals and succession pathways were used to build models for the timber, woodland, and some shrub PNV types on the GMUG. Current conditions were then compared to model results to see where departures exist (Table 2). Generally speaking, the spruce-fir cover type was dominated by late-mid and late seral stages as compared to modeled PNV. The natural and human disturbance histories for the different geographic areas were reflected in the current conditions as of 2006. Areas with more recent activities/disturbances had higher percentages in the earlier seral stages. Areas where disturbance regimes had been interrupted (i.e., fire suppression) tended to have higher percentages in the later seral stages, typically much higher than would have occurred historically when disturbances were not suppressed. Note that acres affected by beetles since 2006 are not reflected in this data.

Table 2. Succession (Seral Stages) in Spruce-fir and Spruce-fir Aspen PNV Types by GA, 2006.

Spruce-Fir PNV	**Early Seral**	**Early-Mid Seral**	**Late-Mid-Seral***	**Late Seral***
VDDT Model - PNV	*27-32%*	*20-24%*	*12-13%*	*31-40%*
Existing Vegetation Condition				
Grand Mesa	8%	40%	52%*	
Gunnison Basin	5%	49%	45%*	
North Fork Valley	14%	32%	53%*	
San Juans	1%	43%	56%*	
Unc. Plateau	3%	45%	52%*	
Spruce-Fir-Aspen PNV	**Early Seral**	**Early-Mid Seral**	**Late-Mid-Seral**	**Late**
VDDT Model - PNV	*13-19%*	*22-29%*	*13-16%*	*35-49%*
Existing Vegetation Condition				
Grand Mesa	5%	63%	32%*	
Gunnison Basin	4%	63%	33%*	
North Fork Valley	6%	69%	25%*	
San Juans	1%	24%	75%*	
Unc. Plateau	3%	45%	52%*	
**These seral stages are considered most susceptible to spruce beetle infestation.*				

Spruce Beetles and Spruce Mortality

The spruce beetle (*Dendroctonus rufipennis*) is the primary disturbance agent for mature spruce trees at high elevation. On the GMUG, spruce beetles are currently attacking mostly Engelmann spruce; they prefer mature, large-diameter spruce trees, but will attack smaller trees once most of the larger trees are exhausted within a stand. The spruce beetle outbreaks are a natural event that eventually lead to the death of old stands and the initiation of new stands; however, warmer winters in recent years have allowed a larger number of beetles to survive. Substantial wind throw events in 2011 and 2012 created prime breeding habitat for spruce beetles, exacerbating

the problem. Consequently, the beetle flight (when new adult beetles emerge from the dead tree) in recent summers has been the largest witnessed by entomologists in decades (USDA Forest Service 2013d, Forest Health Protection).

Once attacked by beetles, most trees typically die and eventually fall to the ground, adding dead and dry fuels that can increase wildfire hazard. Standing infected trees also increase the risk of wildfire; in the first two years of a bark beetle outbreak when dead trees still have red needles, the likelihood of crown fires and ember lofting are higher. The red, dead needles that cling to the trees provide fuel that can ignite quickly during weather conditions conducive to fire (Page and Jenkins 2007). The short-term burst in elevated fire hazard associated with the red needle phase poses an increased safety hazard for wildland firefighters engaged in tactical suppression of wildfires that threaten WUI and infrastructure outside WUI. Though spruce-fir wildfire severity, including extent and frequency, is driven by climate, wildfire *behavior* in recently-dead spruce-fir and areas with heavy fuel loadings can create more unpredictable fire behavior that is more hazardous to manage.

Falling dead trees also have the potential to cause property damage and pose risks to human safety. Trees falling across roads and trails could block ingress/egress during emergency operations, such as during wildfire suppression operations. Falling tree hazards continue to increase the longer dead trees remain standing. In WUI areas, fuel treatments can increase defensible space and provide safe locations from which firefighters can initiate fire management actions.

Beetle outbreaks commonly occur following windthrow events. Several current spruce beetle activity centers on the GMUG are known to have been initiated by windthrow. These types of events are referred to as “eruptive” because beetles are produced locally in response to on-site conditions (e.g. blow-down of trees creating ideal habitat for beetles). Eruptive populations typically result in patchy mortality and infestation is at a much slower rate. Beetle activity on the Grand Mesa is currently operating as an eruptive population. Other spruce beetle activity centers have apparently originated from the beetles themselves dispersing during wind events. Sustained dry, windy weather over the past ten years has contributed to the epidemic (Pielke et al. 2005, Worrall et al. 2013, Worrall and Rehfeldt 2013). In these types of events, beetle populations are referred to as “inundative” because beetles are emigrating en masse from other locations. Inundative populations typically result in much higher tree mortality as seen on the southern-end of the Gunnison Ranger District. Tree ring records and recent weather data indicate that the past decade has been the hottest and driest in centuries (Worrall et al. 2013, Worrall and Rehfeldt 2014).

In addition, there are several documented climate trends across the western United States creating conditions conducive to beetle outbreaks:

- More precipitation in the form of rain, and less in the form of snow (Knowles et al. 2006), coupled with declining snowpack (Mote et al. 2005).
- Earlier peaks in streamflow (Stewart et al. 2005). This can already be seen in recent streamflow records set in the last few years in the area below the GMUG.
- Earlier spring onset (Cayan et al. 2001).

These climate patterns, together with disturbance such as windthrow and vast areas of susceptible forest, are supporting huge outbreaks across the landscape.

Each year the USDA Forest Service and the Colorado State Forest Service work collectively to aerially monitor insect and disease caused tree mortality or damage across all ownerships of Colorado's forested land. From 2002-2009, spruce beetle damage averaged in the range of 50,000 to 100,000 acres annually. The 2014 aerial forest health survey highlights revealed that the number of acres damaged has increased dramatically, rising to 485,000 acres statewide, an increase of 232,000 new acres. Spruce beetle expansion on the Gunnison National Forest alone was 54,000 new acres affected on 79,000 active acres (USDA Forest Service 2014d, Forest Health Protection), rising to a cumulative total of 223,000 affected acres to-date, or approximately 30% of the total spruce-fir vegetation on the GMUG.This increase in activity is indicative of a rapidly expanding outbreak. Based upon patterns of bark beetle kill that have occurred on adjacent Forests, continued and rapidly increasing mortality can be expected (Worrall et al. 2013, Worrall and Rehfeldt 2013).

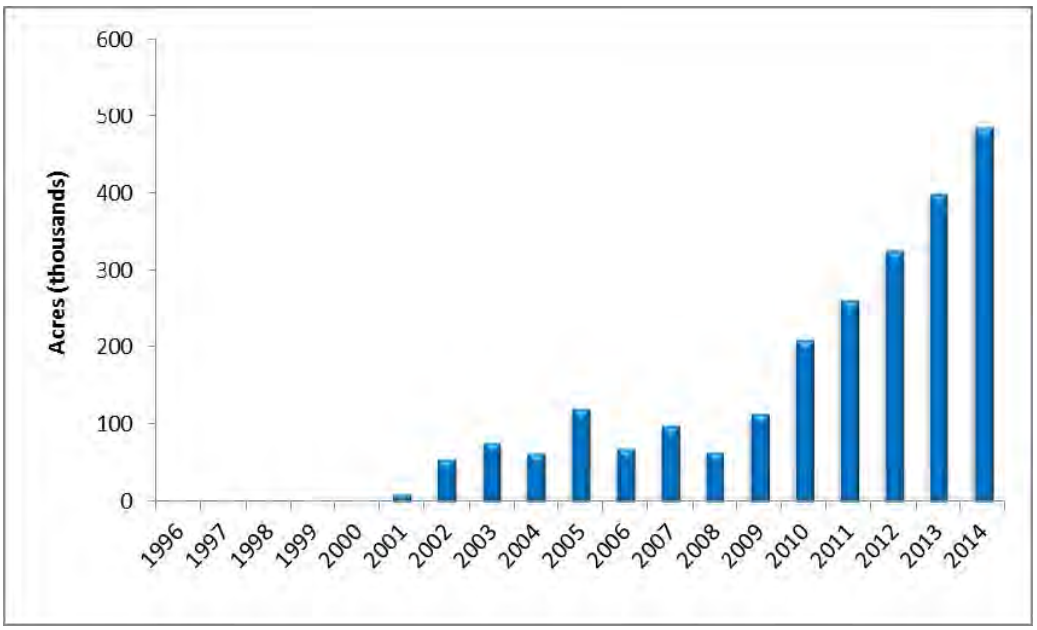

Figure 2. Annual acres affected by spruce beetle in Colorado (USDA Forest Service 2014d, Forest Health Protection).

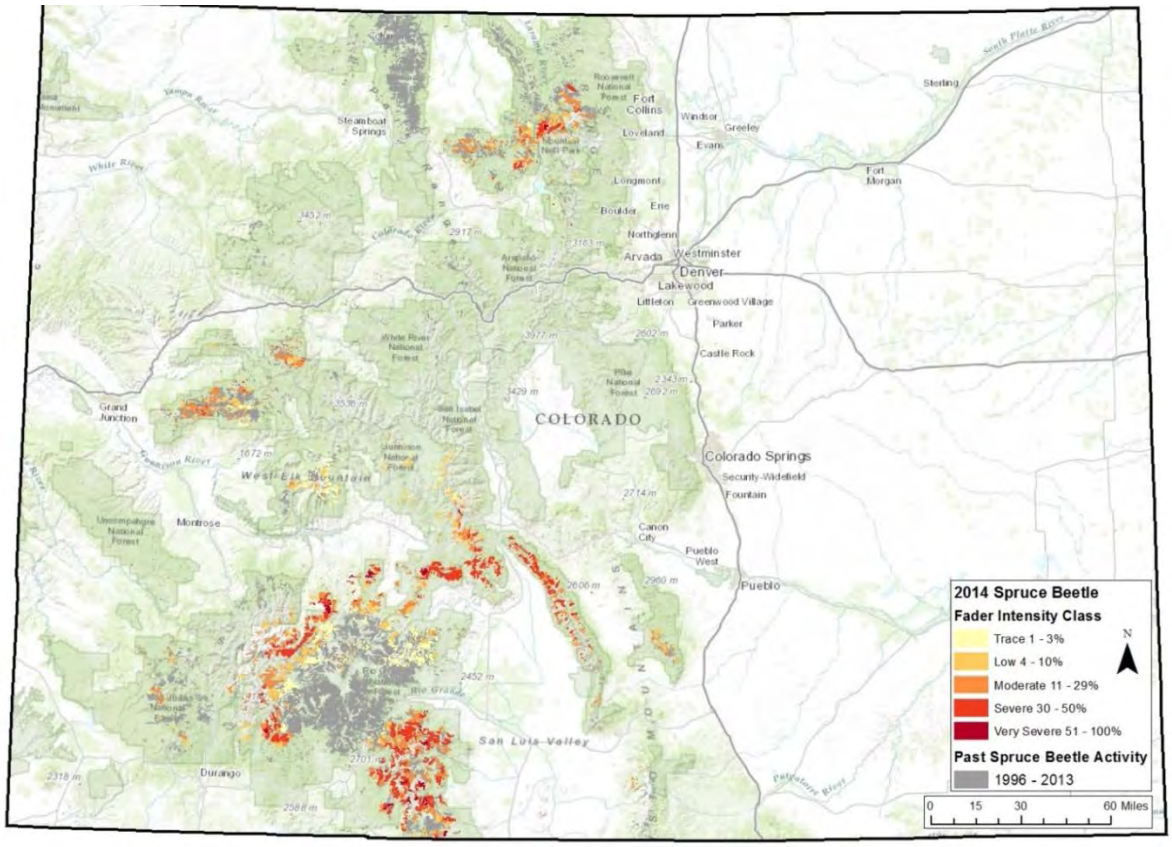

Figure 3. Spruce beetle activity in Colorado 1996-2014 (USDA Forest Service 2014d, Forest Health Protection).

Generally trees down to 8 inch dbh and in some cases smaller trees are being affected (Eager, pers. comm). Most (>90%) of mature over-story trees are dying from beetle infestation in affected areas, usually within 18 months to 2 years. Regeneration of the understory can be extensive in some instances and lacking in others. Where regeneration occurs, the stand is shifted from mature (habitat structural stage 4B and 4C) to shrub-seedling (habitat structural stage 2T/2S) or sapling pole (habitat structural stage 3A).

Effects of Climate Change on Engelmann Spruce

The warming trend on the GMUG is expected to continue, with temperatures increasing 5.4 F to 7.0 F by the years 2040 – 2060 (Mearns and Barsugli, 2009). Although there has been no major trend in the Gunnison River stream flow over the past 60 years, there has been a trend toward earlier snowmelt and peak stream flow, leading to a longer growing season, which in turn increases the demand for water needed for healthy forests. Projections for annual precipitation range from a 10% decrease to no change. Most research for mid-latitude locations indicates the greatest temperature change should be at high elevations, where spruce-fir forests tend to occur. Even with no change in precipitation, the longer, warmer summers could lead to severe moisture stress. In order to explore effective methods of forest management under changing climatic

conditions, a bioclimatic model created by Rehfeldt, et al. (2006) was used to project changes in climatic suitability for spruce in the western United States. Results projected a 47% drop in suitable spruce habitat in the decade around 2060, and a 72% loss of spruce habitat by 2090. Only 23% of habitat was expected to persist in place through 2100 (Rehfeldt, et. al 2006).

For application on the GMUG, the bioclimatic model was rebuilt using local data, more topographical predictors, newer global climate models (GCMs) and carbon scenarios, and higher-resolution climate data (Rehfeldt *et al.* 2015). The decade surrounding 2060 was selected as the target timeframe. Projections are an average of those from three GCMs and three greenhouse gas emission scenarios.

Habitat for spruce was classified into the following four zones, using the decade 2060 as the target timeframe:

- Lost Habitat – future climate is so unfavorable that spruce is unlikely to survive the century.
- Threatened Habitat – future climate will be unfavorable, but climate-based seed transfer guidelines and low basal areas may allow spruce to persist.
- Persistent Habitat – future climate is expected to be minimally favorable to favorable, through 2060.
- Emergent Habitat – Future climate is expected to be suitable to spruce; these areas are currently outside spruce habitat.

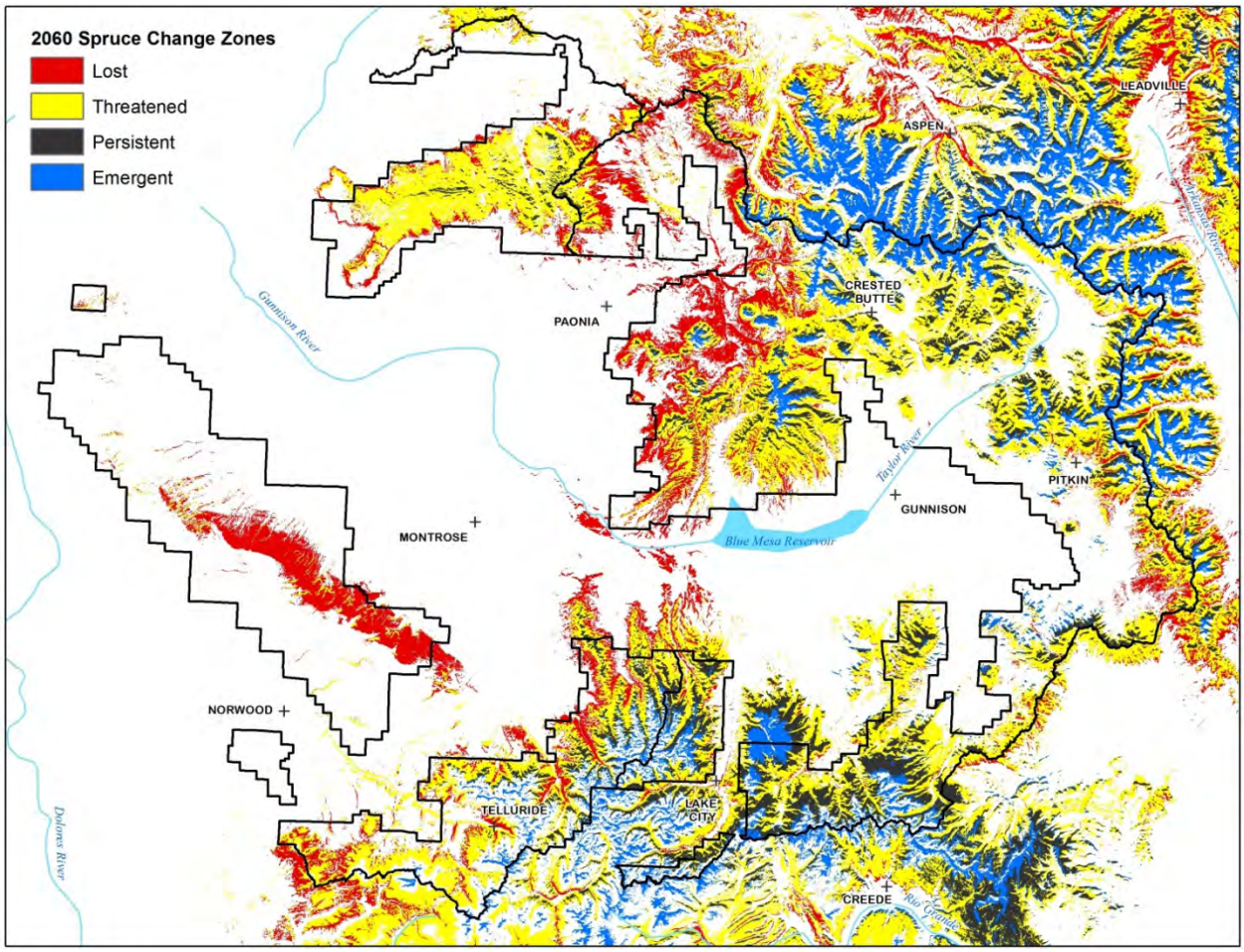

Figure 4. Future climatic habitat zones of Engelmann spruce.

The Rehfeldt (2015) model (Figure 4) projects little remaining habitat for spruce on the Uncompahgre Plateau, and substantial loss in the West Elk Mountains, east of Grand Mesa, and south of the Black Canyon/Blue Mesa Reservoir. Much of the Grand Mesa and low elevations elsewhere are in the threatened zone. Increases in suitability (emergent habitat) are expected in high elevations in the eastern part of the GMUG. About 22% of the current spruce distribution is classified as lost and 58% is classified as threatened, meaning that it is conceivable that 80% of current spruce distribution may not continue into the next century. Projected rates of climate change are faster than the response rate of natural systems (Davis, Shaw, and Etterson, 2005). Thus, if no forest management action is taken, it will most likely result in the gradual conversion of spruce forests in "lost" and threatened zones to other forest and non-forest cover types (Rehfeldt, et al., 2015).

Aspen

Aspen is an important component of GMUG's forests. Over 712,000 acres of aspen-dominated forest type occur across the GMUG.

Aspen is a unique and important tree species in western North America, where aspen is the most diverse upland forest type. Of roughly 1,669 species of wood-decay fungi tallied in North America, Gilbertson (1980) noted 260 on aspen, more than on any other tree species, many of which are specialized on aspen. Bird species richness and total abundance are higher in aspen stands than in other North American montane habitats (e.g., Turchi *et al.* 1995), and many species show strong preferences for aspen trees or forests for nesting habitat (Flack 1976). Aspen modifies soil properties and microclimate in ways that foster luxuriant growth of varying herb and shrub layers, and are therefore major contributors to plant species diversity (Kuhn *et al.* 2011, Mueggler 1985). Aspen improves streamflow and habitat for plants and animals by improving water movement. Results of modeling based on rates of water movement by season in various tree species suggested significantly greater water yield from aspen than from conifer forests (Gifford *et al.* 1984). The importance of aspen communities to large ungulates such as elk is well known, and in dry forest ecosystems, patches of aspen are also hotspots of diversity for small mammals (Oaten & Larsen 2008). Thus, aspen is truly a keystone species, and as such its loss leads to substantial alteration of habitat conditions and loss of species diversity.

In addition, aspen forests have significant economic value based on tourism and fiber production. Esthetically, aspen contribute a major share of Colorado's scenic beauty. Tourism is the second largest industry in Colorado, with tourists spending $17 billion in the state in 2012 (Tourism Pays, Denver Convention and Visitor Bureau). The properties of aspen wood make it valuable for paneling, oriented strandboard, excelsior and chips (used in erosion control and oil-spill cleanup), all of which are or were produced in southwestern Colorado.

Finally, aspen forests, like other forest types, store considerable carbon in above- and below-ground biomass (and especially for aspen, in the soil). As aspen stands mature and regenerate, there is a cycle of carbon release and sequestration with a high net storage of carbon. If aspen forests are replaced by shrub or meadow communities with lower carbon storage capacities, the difference will contribute to atmospheric CO_2. Aspen mortality episodes in the aspen parkland of Alberta and Saskatchewan and in southwestern Colorado are expected to result in significant carbon release and positive feedbacks to climate change (Huang & Anderegg 2012, Michaelian *et al.* 2011).

Habitat structural stages for the aspen cover type for each geographic area on the GMUG, as assessed in 2006, are presented in Table 3 (USDA Forest Service, 2006e). Overall, aspen was dominated by mature and dense stand conditions (4B and 4C) across all GA. Where age data existed, most aspen ranged from 80 to 120 years old. The highest percentage (>70%) of stands in a mature condition existed on the Grand Mesa, San Juan Mountains and the Uncompahgre Plateau. The following section, *Sudden Aspen Decline (SAD),* concludes with a discussion of how sudden aspen decline on the GMUG has shifted structural stages.

Table 3. Current Aspen Vegetation Characterization for GMUG by Geographic Area, 2006.

GA	Cover Type	Composition of GA	Age Distribution	Habitat Structural Stages[1]	Canopy Conditions
Gunnison Basin	Aspen	197,500 acres (14%)	Most aspen is between 80 to 120 years old.	3A - 9% 3B – 34% 3C – 10% 4A- 5% 4B – 22% 4C – 21%	26% single-storied 74% multi-storied 96% continuous canopy
Grand Mesa	Aspen	94,500 acres (26%) (60% pure aspen, 39% with spruce-fir in species mix, 1% with other tree species in mix)	Ranges from 16 to 131 years. Most aspen is between 80-120 yr. old.	2T- 2% 3A – 2% 3B- 10% 3C- 3% 4A – 1% 4B- 28% 4C- 54%	27% - single-storied 73% - multi-storied 98% - continuous canopies
San Juan Mountains	Aspen	76,200 acres 20%.	Age data not available	3A – 9% 3B – 12% 3C – 1% 4A – 4% 4B – 71% 4C – 3%	82% - single-storied 18% - multi-storied 71% - continuous canopies
North Fork Gunnison River	Aspen	212,600 acres 40%.	Age data not available	2T - <1% 3A – 7% 3B – 41% 3C – 6% 4A – 3% 4B – 16% 4C- 26%	40% - single-storied 60% - multi-storied 99% - continuous canopies
Uncompahgre Plateau	Aspen	160,100 acres 25% of NFS lands 4% of total GA 71% of aspen is on NFS land.	Most aspen is between 80-120 yr. old.	2T – 1% 3A – 9% 3B – 25% 3C- 3% 4A – 2% 4B – 44% 4C – 16%	65% - single-storied 35% - multi-storied 86% - continuous canopies

[1]Habitat Structural Stage	Size Class	Diameter	Crown Cover Percent
1T/1M	Grass-Forb	Not applicable	0 – 10%
2T/2S	Shrub-Seedling	< 1 inch	0 - 10%
3A	Sapling-Pole	1 – 9 inches	11 – 40%
3B	Sapling-Pole	1 – 9 inches	41 - 70%
3C	Sapling-Pole	1 – 9 inches	71 - 100%

GA	Cover Type	Composition of GA	Age Distribution	Habitat Structural Stages[1]	Canopy Conditions
4A		Mature	9+ inches	11 – 40%	
4B		Mature	9+ inches	41 - 70%	
4C		Mature	9+ inches	71 - 100%	

Generally speaking, the aspen cover type was dominated by late-mid and late seral stages as compared to modeled PNV (Table 4; USDA Forest Service, 2006e).

Table 4. Succession (Seral Stages) in Aspen PNV Types by GA, 2006.

Aspen PNV	Early Seral	Early-Mid Seral	Late-Mid-Seral	Late
VDDT Model - PNV	*8-14%*	*23-26%*	*17-24%*	*23-43%*
Existing Vegetation Condition				
Grand Mesa	3%	15%	82%*	
Gunnison Basin	6%	43%	50%*	
North Fork Valley	5%	58%	36%*	
San Juans	4%	25%	72%*	
Unc. Plateau	13%	41%	46%*	

Sudden Aspen Decline (SAD)

SAD was first noticed in southwestern Colorado in 2004 (Worrall *et al.* 2008). On the San Juan National Forest, large and growing patches of crown thinning, branch dieback, and mortality were found. It occurred on a landscape scale and rapidly increased in area and severity. Over the next few years, SAD spread to the Uncompahgre Plateau, the Grand Mesa, and the Gunnison River basin. Aspen throughout Colorado was affected. In 2008, 543,630 acres were affected in Colorado (Worrall *et al.* 2010). About 45% of that area was rated as “severe”, indicating estimated mortality over 50% of the overstory.

From 2000-2010, 1,322,000 acres were impacted by SAD in the Southern Rocky Mountains ecoregion, with 1,216,000 acres in Colorado (an estimated 17% of the aspen cover type in the state) (Worrall *et al.* 2013). The GMUG was affected more severely, with approximately 31% (over 229,000 acres) of the GMUG’s aspen affected from 2000 to 2010. In 2009, the detection of new areas dropped considerably, with few new areas mapped since that time. However, stands currently exhibiting SAD continue to decline, so aspen mortality continues.

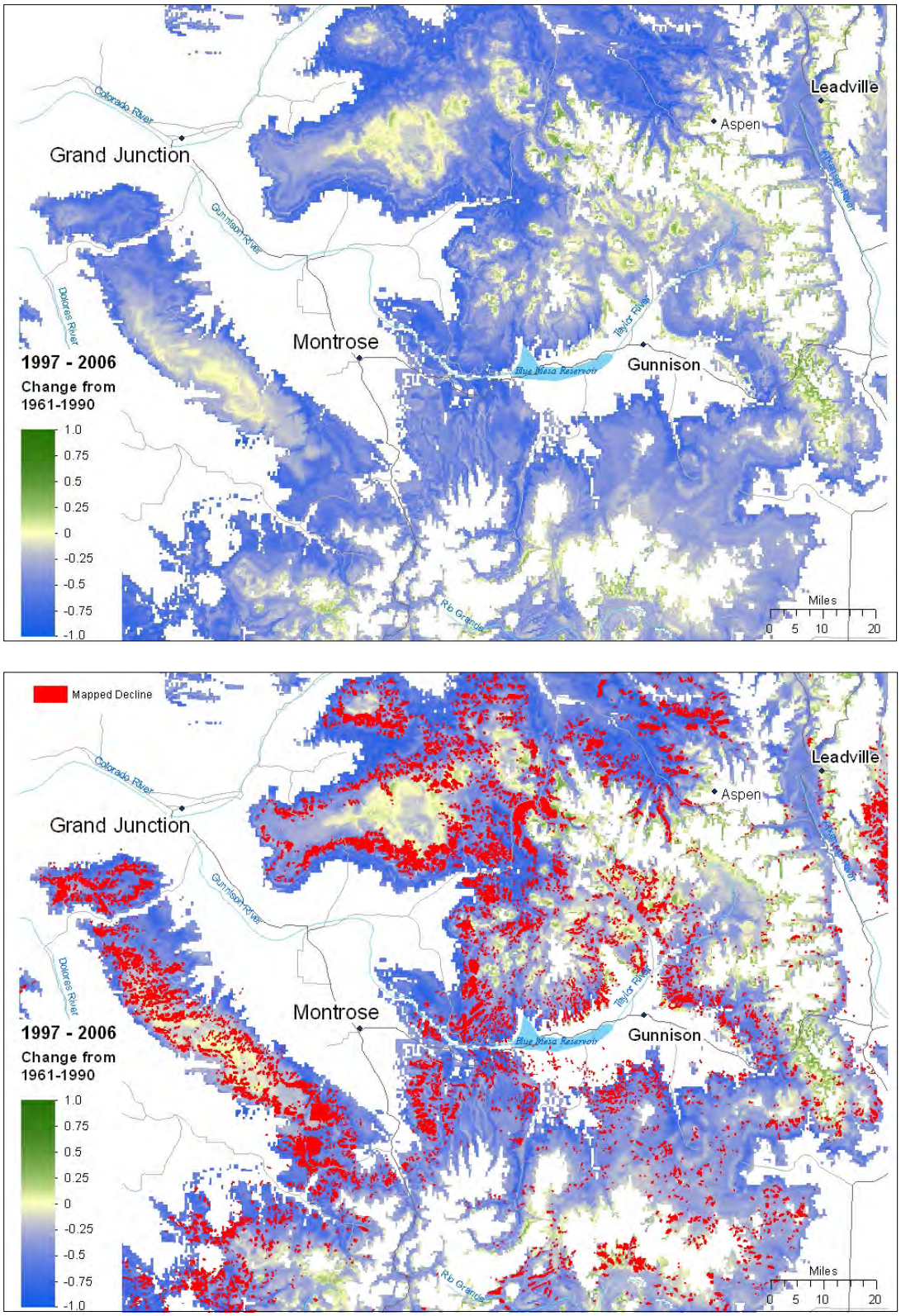

Figure 5. Change in climatic suitability for aspen (top) and overlying mapped aspen decline (bottom) (Worrall et al. 2013).

In Figure 5, the top map and underlying layer of bottom map indicates change in climatic suitability for aspen between the reference period, 1961-1990, and the decade preceding and accompanying the recent episode of SAD, 1997-2006 (provided by Andreas Hamann, Univ. Alberta). Blue indicates decrease in suitability; green an increase. SAD tended to occur where climate suitability decreased (blue areas do not necessarily have significant aspen). The mapped decline of aspen, show in red on the bottom map, is from aerial survey data gathered 2000-2010.

Although the cause of SAD was initially unknown, examinations of outbreaks found a link between moisture stress and SAD. Damage was highest at low elevations, where temperature is high and precipitation is low (Dudley 2011, Worrall *et al.* 2008). Damage tended to be high on south and west-facing slopes and on the shoulders and summits of slopes (Huang & Anderegg 2012, Worrall *et al.* 2008). Southwestern Colorado had a drying trend from the mid-1980s to 2002, culminating in a record drought in much of Colorado (Pielke *et al.* 2005). In 2002, areas with SAD had lower values of climate moisture index than did aspen areas that remained healthy (Worrall *et al.* 2010). Various moisture indices showed that the area underwent a protracted, severe moisture deficit (Worrall *et al.* 2013). Climatic suitability for aspen generally decreased around the time of SAD, and SAD tended to occur in marginal sites where suitability decreased the most (Figure 5).

While the evidence that severe, warm drought incited SAD was clear, a broader view gives a more comprehensive concept of the cause. Stand conditions, especially low density and openness, may have also predisposed stands to damage. Aspen bark beetles, bronze poplar borer, poplar borer, and Cytospora canker killed trees that had been stressed by drought (Marchetti *et al.* 2011). Thus, the predisposing and contributing factors played important roles, in addition to the inciting factor, drought.

A ground survey in 2007 and 2008 sampled the entire GMUG and the Mancos-Dolores Ranger District of the San Juan National Forest (Worrall *et al.* 2010). Areas identified as SAD by aerial survey had an average 54% recent crown loss and 45% mortality. SAD plots had higher root mortality than healthy plots (Worrall *et al.* 2010), and regeneration counts showed no evidence of increased suckering in response to the overstory damage (Dudley 2011, Worrall *et al.* 2010). Some patches of aspen at the lower-elevation fringe were completely dead with no regeneration. Remote sensing over 2009-2011 suggested that 30% of the total aboveground aspen biomass was dead in a large section of southwestern Colorado, with the resulting carbon emissions expected to provide an amplifying feedback to climate change (Huang & Anderegg 2012).

Approximately 54%% of the stands on the GMUG are experiencing regeneration, shifting the stand to a younger age class. Approximately 46% of the affected stands have limited (<120 stems/acre) or no regeneration.

SAD vs. "Aspen Decline"

As described, sudden aspen decline is a rapid, landscape-scale deterioration of overstory aspen incited primarily by drought and warm temperatures. It is often confused with an older concept of "aspen decline". The latter refers to a long-term (over many decades) decrease in the area of aspen due primarily to succession (Bartos 2001, Bartos & Campbell 1998). Factors that have been suggested to lead to it include a large increase aspen associated with fires during the time of European settlement, subsequent fire exclusion, and overgrazing (Bartos & Campbell 1998, Kulakowski *et al.* 2004).

Effects of Climate Change on Aspen

Due to expected increases in dry weather, especially drought, more cases of SAD are expected. Suitability for aspen in the Southern Rockies is expected to deteriorate rapidly through the rest of the century. Rehfeldt's (2015) bioclimatic model (Figure 5) and studies on climatic change point to a complete loss of aspen in some lower-elevation sites and on south slopes, while at the other extreme, aspen habitat is expected to persist and newly suitable habitat may emerge at higher elevations and north slopes.

As with spruce, aspen were also classified into suitable habitat by geographic zones based on expected climatic changes (Rehfeldt *et al.* 2015) .

- Lost Habitat– future climate will be so unfavorable that aspen is unlikely to survive the century.
- Threatened Habitat– future climate will be unfavorable, but young stands will probably survive. Opportunities would exist to treat to distribute young patches on landscape and to help SAD stands recover.
- Persistent Habitat – future climate will remain suitable for aspen. No climate-change adaptation needed, but normal management may proceed. Opportunities would exist to promote existing aspen near emergent habitat.
- Emergent Habitat – future climate will become suitable; areas are currently outside distribution. Opportunites to facilitate migration into this zone would exist, via allowing or creating disturbance (mechanical and/or fire).

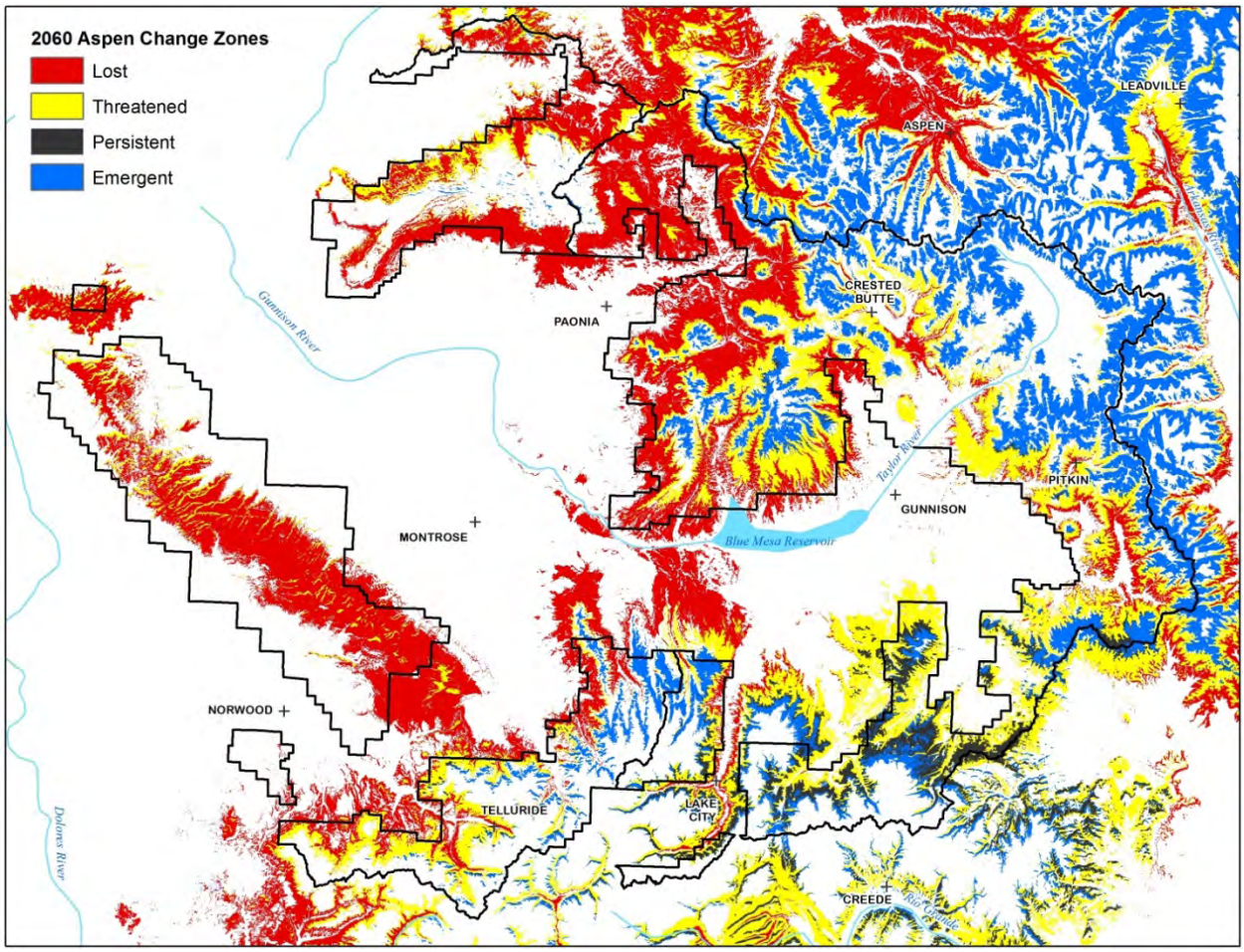

Figure 6. Future habitat zones of aspen.

Results of the bioclimatic model show that 52% of the current aspen distribution on the GMUG is in the lost category and 42% is in the threatened category, meaning it is conceivable that 94% of current aspen distribution may not continue into the next century (Figure 6). In general, habitat will be lost at low elevations, especially on south aspects, while new habitat will emerge at elevations above the current distribution of aspen. Little suitable habitat is expected to remain on the Uncompahgre Plateau, the southern and eastern fringes of the Grand Mesa, and the western West Elks. The remainder is largely threatened, as persistent habitat is mostly limited to the southeastern portion of the GMUG. However, there are substantial areas of Emergent habitat in the higher elevations.

The following tactics have proven effective for aspen management:

1. Aspen stands dying from SAD can be regenerated when less than 50% of the stand has been affected. Stands can be treated by removing overstory through coppice cuts and prescribed fire.

2. Young stands of less than 40 years old have been found to be more resilient to drought; ensuring that there are significant patches of aspen under 40 years old will increase resilience of aspen clones.
3. Preparing a seed source and seedbed can facilitate aspen migration into newly suitable habitat.

The following strategy is recommended by Worrall, et al., (2014) to employ the climate change projections:

1. **Resilience**: regenerate patches of mature aspen, or mixed stands with an aspen component in threatened habitat zone to increase younger component on the landscape.
2. **Recovery**: Treat previously affected SAD stands to aid recovery and regeneration, but do not treat in the "lost" zone.
3. **Migration**: Conduct treatments and/or allow natural disturbances to proceed in the persistent and emergent habitat zones in order to facilitate self-migration of aspen.

During extreme climate periods causing new SAD episodes, it may be necessary to prioritize resilience treatments in new SAD patches before canopy loss reaches 50%. Such treatments should also concentrate on the threatened habitat zone.

It should be recognized that while the bioclimatic model is quite effective at replicating the distribution of spruce and aspen at large scales. At smaller scales errors of omission (predicting absence where spruce/aspen occur) and errors of commission (predicting presence where no spruce/aspen occurs) can be seen. Climate projections are based on a representative carbon pathway that may not represent the actual future trend in greenhouse gasses. For example, conditions projected for 2060 could occur sooner if emissions are higher than projected or later if they are lower. For these reasons, although boundaries between future habitat zones must be precise for planning purposes, ideally they should be regarded as a best estimate and the timing of projected changes as likely but uncertain.

Project Area

This project – Spruce Beetle Epidemic and Aspen Decline Management Response project (SBEADMR) – includes stands affected by the spruce beetle epidemic and sudden aspen decline, including those that are considered threatened or at high risk. The geographic area covered by this project includes spruce, aspen, and spruce/aspen mix on National Forest System (NFS) lands within the GMUG, excluding designated Wilderness Areas, Roadless Areas, or are designated as a special area (Research Natural Areas, Botanical Areas, etc.). Figure 7 displays the location of the SBEADMR Project Area.

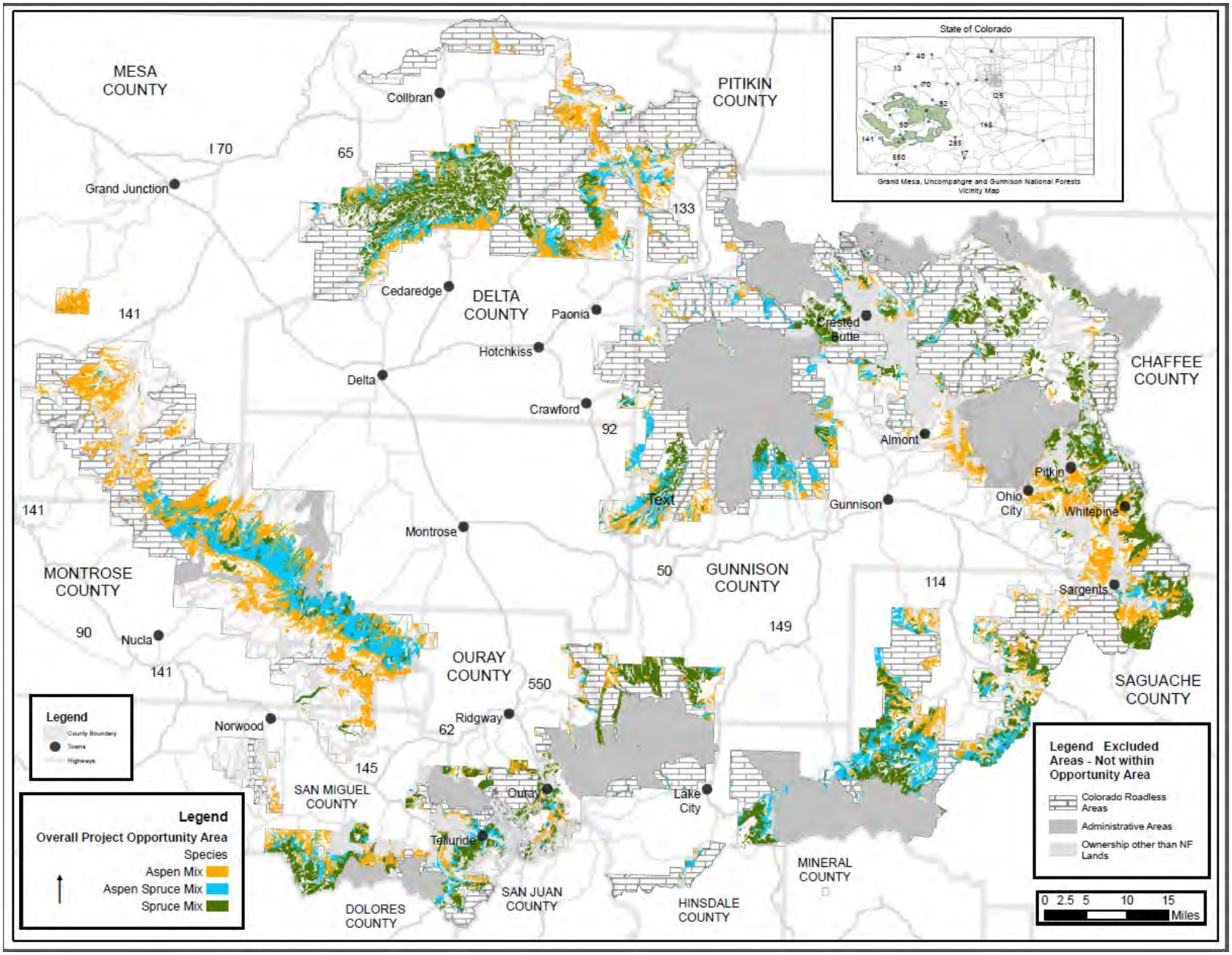

Figure 7. SBEADMR Project area. Spruce and aspen vegetation within the GMUG forest boundary, outside Wilderness, Roadless Areas, and other designated areas.

Purpose and Need for Action

The purpose of the project is to reduce the safety threats of falling, dead trees and of managing wildfires on the landscape (safety); improve the resiliency of stands at-risk of insect and disease (resiliency); and to treat affected stands via recovery of salvageable timber and subsequent re-establishment of desired forest conditions (recovery). Given the substantial mortality of spruce-fir and aspen forests on the GMUG over the past decade, the need for the project is to manage forest vegetation to bring current and foreseeable conditions closer to desired conditions on landscapes available for active management. On these landscapes, vegetation management would be used to help sustain or promote potential natural vegetation types. Desired conditions include a balance of habitat structural stages, tree species composition, and seral stage distributions that are appropriate for each vegetation type across the geographic areas of the GMUG (See Figure 1). Furthermore, in the context of a changing climate conducive to more frequent and extensive wildfires in forests at high elevation irrespective of tree condition (Westerling et al. 2006, Agee 2007; Funk 2012; Rangwala and Rondeau, unpub.), desired conditions for fire and fuels management include more locations across the landscape from which firefighters can safely and effectively manage or suppress fires for values at risk and/or resource benefit.

The following goals elaborate on the stated purpose:

Public Safety[1]

1. Remove hazard trees proximal to roads, utility corridors, communication sites, dispersed recreation sites, developed campgrounds and other recreation sites, and within ski areas both within and outside the wildland urban interface (WUI).
2. Increase the extent of defensible space around values at risk.
3. Provide safer locations from which firefighters can initiate fire management actions.

Resiliency

1. Increase the forest's ability to respond to multiple and interacting stresses, including climate change, insect attack, drought or disease.
    a. In healthier spruce-fir stands, promote regeneration and create multiple age classes of trees.
    b. Minimize spread of bark beetle from infected stands to neighboring healthy stands.
    c. Promote aspen regeneration via active treatments in live stands, with emphasis on those affected by Sudden Aspen Decline.

Recovery

[1] Note that treatments to meet public safety goals may simultaneously meet recovery or resiliency goals.

1. Provide commercial forest products to local dependent industries at a level commensurate with Forest Plan direction and in harmony with other Plan goals (1991 GMUG Amended Forest Plan, p. III-3).
2. Subsequent to treatment, treat fuels, prepare sites, and re-establish and maintain forest cover via replanting where seed sources are lacking.

The purpose and need is adapted from the Western Bark Beetle Strategy (USDA Forest Service, 2011i) and furthers goals identified within the National Cohesive Wildland Fire Management Strategy (USDA & USDI 2014).

Proposed Action

The Forest Service developed the Proposed Action (Alternative 2) to meet the purpose and need outlined above.

The total Alternative 2 opportunity area is 718,000 acres where commercial, non-commercial mechanical and prescribed fire treatments could be implemented. The *opportunity area* includes spruce and aspen forest types analyzed for treatment in this EIS on the GMUG. This is the maximum extent of opportunity area for Alternative 2, yet opportunities for commercial and non-commercial treatment have distinct spatial parameters within this total opportunity area. Outside of public safety areas, commercial treatments would *only* occur within 24 identified Lynx Analysis Units (LAUs) on lands identified as suitable timber, comprising an area of 278,000 acres. Suitable timber lands are designated per the 1991 Forest Plan. A high percent of the suitable timber areas within spruce on the Forest are contained in this subset of the total LAUs on the GMUG, making this a cost-effective, distinct spatial area to analyze and commercially treat. These 24 LAU have also been identified by the Forest Service Gunnison Service Center as areas in which spruce beetle will likely be affecting spruce trees in the foreseeable future. Non-commercial treatments would be primarily focused *outside* suitable lynx habitat and could be implemented across the 718,000 total opportunity acres.

Of the total opportunity area for the Proposed Action, the EIS analyzes a maximum of 120,000 acres of commercial and noncommercial *treatments* over the approximately 8-12 year implementation timeframe of the project. Therefore, a maximum of 120,000 acres of the 718,000-acre Proposed Action opportunity area would be treated via SBEADMR. Approximately 60,000 acres would consist of commercial mechanical treatment, and approximately 60,000 acres would consist of noncommercial mechanical and prescribed fire treatments.

Commercial mechanical treatment is ground-based mechanized timber cutting on lands suitable for timber harvest that produces a commercial product. Non-commercial mechanical treatment, is ground-based mechanized timber cutting that does not produce a commercial product, and

includes use of mechanized equipment for tree cutting, mastication, and hand treatments using chainsaws. Prescribed fire includes broadcast burns and pile burns.

The Proposed Action, as with each action alternative, would be implemented using an Adaptive Implementation Framework, as detailed further in Chapter 2.

Management Direction and Strategies

Direction and national strategies guiding the proposed action and action alternatives is summarized below.

National Policy and Direction

Ecological Restoration and Resilience (FSM 2020)

Forest Service policy on ecological restoration and resilience was first written as an interim directive in 2008, and revised in 2010, 2011, and 2013. Final Forest Service policy on these topics was proposed in 2013. The proposed directive provides broad foundational policy for using ecological restoration to manage National Forest System lands in a sustainable manner. The policy spans all resource areas and activities applicable to land management and establishes a common definition for ecological restoration and resilience that is consistent with the 2012 Land Planning rule. The discussion below follows the latest (2013) interim directive, because that is current Forest Service policy.

The objective of restoration is stated as follows:

"The aim is to reestablish and retain ecological resilience of National Forest System lands and associated resources to achieve sustainable management and provide a broad range of ecosystem services. Healthy, resilient landscapes will have greater capacity to survive natural disturbances and large scale threats to sustainability, especially under changing and uncertain future environmental conditions, such as those driven by climate change and increasing human uses." (FSM 2020.2, Objective, interim directive).

Ecological restoration activities may include recovery from high-severity fires, restoring terrestrial and aquatic habitat, and watershed restoration treatments, among others. The policy incorporates consideration of increased human use and climate change on National Forest System lands when developing restoration and resilience activities. The directive reinforces the use of adaptive management, scientific information, and collaboration in agency planning and decision-making.

The directive defines restoration as:

"The process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed. Ecological restoration focuses on establishing the composition, structure, pattern, and ecological processes necessary to facilitate terrestrial and aquatic ecosystem sustainability, resilience, and health under current and future conditions." (FSM 2020.5).

Adaptive management is defined as:

"A system of management practices based on clearly identified outcomes and monitoring to determine if management actions are meeting desired outcomes, and if not, to facilitate management changes that will best ensure that outcomes are met or reevaluated. Adaptive management stems from the recognition that knowledge about natural resource systems is sometimes uncertain." (36 CFR 219.16; FSM 1905; FSM 2020.5). In context of the SBEADMR project, desired outcomes are associated with tree species and structural stand conditions and successful implementation of project design features designed to minimize/eliminate impacts to natural resources.

National Strategy

Western Bark Beetle Strategy

The Western Bark Beetle Strategy (USDA Forest Service, 2011i) was developed in response to current bark beetle epidemic in the western United States. The strategy addresses the three prongs of the bark beetle problem: human safety, forest recovery, and forest resiliency. Due to budget constraints and the scale of the epidemic, the Forest Service recognized it could not treat all affected acres, and the Strategy prioritized treatments areas with human safety as the first priority, followed by recovery and resiliency.

National Cohesive Wildland Fire Management Strategy

In the Federal Land Assistance, Management, and Enhancement Act of 2009 (FLAME Act), Congress mandated the development of a national cohesive wildland fire management strategy to comprehensively address wildland fire management across all lands in the United States. Shortly after enactment of the FLAME Act, a three-phased, intergovernmental planning and analysis process involving stakeholders and the public was initiated: the National Cohesive Wildland Fire Management Strategy, more commonly referred to as the Cohesive Strategy. Its vision for the next century is "to safely and effectively extinguish fire, when needed; use fire where allowable; and as a Nation, live with wildland fire" (USDA & USDI). The Cohesive Strategy is an effort to work collaboratively among all stakeholders and across all landscapes, using best science, to make meaningful progress towards three identified goals: resilient landscapes, fire-adapted communities, and safe and effective wildfire response. The SBEADMR project is informed by the Cohesive Strategy's identified goal of achieving and maintaining resilient landscapes via fire and non-fire vegetation and fuels management.

Forest Plan

The 1991 Grand Mesa, Uncompahgre and Gunnison National Forests Amended Land and Resource Management Plan (Forest Plan), is the programmatic document required by the rules implementing the Forest and Rangeland Renewable Resources Act of 1974 (RPA) as amended by the National Forest Management Act of 1976 (NFMA). The purpose of the Forest Plan is to provide direction for the multiple use and sustained yield of goods and services from NFS lands in an environmentally sound manner. The Forest Plan provides overall goals and objectives, standards and guidelines, and management area-specific goals and objectives that direct management of the Grand Mesa, Uncompahgre and Gunnison National Forests. The Forest Plan can be viewed online on the Grand Mesa, Uncompahgre and Gunnison National Forests website: Amended Land and Resource Management Plan,
1991 http://www.fs.usda.gov/detail/gmug/landmanagement/planning/?cid=fsbdev7_003229

The SBEADMR project is consistent with general management direction identified in the amended GMUG Forest Plan. General direction pertinent to this analysis include vegetation management, cultural resources, wildlife resources, old growth management, forest products, water quality, economics, air quality, fire, insects and disease, and soil resources (Forest Plan, 1991, pp. III-2 through III-5).

General Direction for Forest Plan Management Areas

The Forest Plan set management allocations for specific uses of land and established twenty Management Areas (MA) within the Forest to meet multiple use objectives (p. III-86). The MAs that overlap with the planning area for the SBEADMR project area are noted in Table 5, along with the percentage distribution of each action alternatives' opportunity area throughout these MAs. Opportunity areas in SBEADMR are the maximum extent of geographic area analyzed for potential treatments; *subset* of the opportunity area would be treated. See Chapter 2, *Opportunity Areas Defined.*

Table 5. Management Area Summary.

Management Area	Description	Alternatives 2 and 4 Percentage Distribution of Opportunity Areas	Alternative 3 Percentage Distribution of Opportunity Areas
1B	Downhill Skiing and Winter Sports	<1%	2%
2A	Semi-Primitive Motorized Recreation Opportunities	9%	18%
2B	Roaded Natural and Rural Recreation Opportunities	3%	7%

Management Area	Description	Alternatives 2 and 4 Percentage Distribution of Opportunity Areas	Alternative 3 Percentage Distribution of Opportunity Areas
3A	Semi-primitive Non-Motorized Recreation Opportunities	<1%	1%
4B	Wildlife Habitat Management For One or More Management Indicator Species	8%	7%
4D	Aspen Management	5%	5%
5A	Big Game Winter Range in Non-Forested Areas	4%	5%
5B	Big Game Winter Range in Forested Areas	2%	2%
6A	Livestock Grazing - Improve Forage Composition	<1%	<1%
6B	Livestock Grazing - Maintain Forage Composition	32%	27%
7A	Timber Management on Slopes Under 40 Percent	36%	25%
10E	Municipal Watersheds	1%	1%
TOTAL		100%	100%

Applicable Standards and Guidelines

All Forest Plan standards and guidelines are 116 pages in length and cannot be summarized here. Applicable standards and guidelines for the SBEADMR project are identified and addressed under unique resource area analysis in *Chapter 3, Affected Environment and Environmental Consequences*. The proposed action and action alternatives are consistent with applicable standards and guidelines, and validation of Forest Plan compliance would be completed during treatment implementation (See Appendix C).

Lands Suited for Timber Production

According to the National Forest Management Act (NFMA) regulations, timber production and commercial harvest generally may only take place on lands classifed as suitable lands (36 CFR 219.14).

As stated in 36 CFR 219.14(c), lands identified as "tentatively suited" for timber production must be further evaluated to determine which lands are "not appropriate" for timber

production to meet the objectives of each alternative analyzed in detail. Pages B-7 to B-10 of the GMUG Forest Plan describe the process used to identify lands not suitable for timber production. Factors used to identify areas not suitable for timber production include low productivity sites, steep slopes (>40%), sites where irreversible damage could occur, and visually sensitive areas. In the GMUG Forest Plan, the Forest evaluated all tentatively suited lands on a site-specific basis using 1:24,000 scale topographic maps together with field verification and on-the-ground knowledge of Ranger District personnel.

Tentatively suited lands which pass through this screen are considered "suited" for timber production; however, during treatment reconnaissance and layout, Forest Service personnel make a *final* determination of suitability based upon these factors and other considerations for resource protection.

NFMA regulations also provide direction regarding resource protection and re-establishment of trees within five years of harvest.

Decision Framework

The SBEADMR Project purpose and need provides the focus and scope of the proposal as related to National and Forest level policy and direction. Given this purpose and need, the Deciding Official (Forest Supervisor) reviews the proposed action, the issues identified during scoping, the alternatives, and the environmental consequences of implementing the proposal and alternatives disclosed in this EIS. This forms the basis for the Deciding Official to make the following determinations:

- Whether or not the proposed alternatives address the issues, are responsive to law, regulation, policy and Forest Plan direction, and meet the purpose of and need for action in the SBEADMR EIS.
- Whether or not the information in this analysis is sufficient to implement proposed activities.
- Which alternative, if any, to approve (decide which alternative or mix of alternatives to authorize).

Public Participation

Based on the rapid spread and epidemic nature of the infestation and decline of spruce beetle infestation and aspen on the GMUG, the Forest Service initially decided to utilize a traditional approach where public comment is sought through scoping. On the spectrium of public participation from inform→consult→involve→collaborate, the GMUG's initial public participation approach for SBEADMR was on the inform/consult end of the spectrum. After conducting formal scoping the Forest Service identified public interest in a higher level of public

involvement and collaboration for the project, which influenced the Forest Service's subsequent strategies for public participation with respect to SBEADMR, discussed in further detail below.

The SBEADMR project was entered into the GMUG's Schedule of Proposed Actions (SOPA) on July 1, 2013. The SOPA for each national forest contains a list of proposed actions that will soon begin or are undergoing environmental analysis and documentation. The SOPA serves as a tool so the public can be-aware of and indicate interest in specific proposals.

On the GMUG website, a project page was established for the SBEADMR so the public could access relevant project documents online throughout the process.

The Notice of Intent to Prepare an Environmental Impact Statement (NOI) was published in the Federal Register on July 31, 2013. The NOI asked for public comment on the proposal from August 2, 2013 to September 1, 2013. A Legal Notice/Opportunity to Comment was published in the Grand Junction Daily Sentinel (the newspaper of record for Forest Supervisor decisions) on August 2, 2013. The Legal Notice provided similar information as the Notice of Intent and identified how and where to provide comment on the project. In addition, a communication plan for the SBEADMR was established and updated throughout the planning process to ensure coordinated outreach and communication for the project.

A scoping letter was mailed to approximately 1,300 potentially interested individuals, including adjacent landowners, federally recognized tribes, other federal agencies, and federal, state and local government representatives on July 29, 2013. The letter included a description of the project area, an overview of the analysis (NEPA) process, a general explanation of the actions proposed, the reasons for the proposal and an invitation to comment. The GMUG received 28 scoping comment letters and emails during the scoping period. Based on the comments received the interdisciplinary team developed a list of issues and concerns associated with the project.

The purpose of the project, the intent to prepare an EIS and the extent of the infestation was discussed with various stakeholder groups and interests by forest and regional officials in concurrence with the joint Forest Service/Colorado State annual survey report on forest health and subsequent to publishing the NOI. In addition, discussions about SBEADMR and the extent of the beetle infestation were conducted with local units of government, various interest groups and county boards of commissioners to address the need for the project and seek comment. Updates and progress reports on the project continued during the analysis with these same stakeholders.

Despite the initial intent of the Forest Service to pursue a more limited inform/consult mode with respect to public participation for the SBEADMR project, after the scoping period and subsequent scoping meetings, stakeholder interest in more extensive involvement was clear. Throughout the SBEADMR development and analysis, the GMUG invested much effort to inform, consult, and involve interested individuals; to explain the purpose and need; to seek input and comment on the

science, ecology, tools and monitoring for the project and to incorporate information that stakeholders felt was important to consider. Extensive documentation, draft information, question and answer documents, implementation tools, science references and resource reports were maintained and posted on the project website and opportunity to comment and receive input/response were afforded to promote understanding, consideration and collaboration on the SBEADMR. Yet direct contact with stakeholders through a variety of public workshops, field trips, and a third-party-facilitated Working Group demonstrated the Forest Service's commitment to move from inform/consult closer to involve/collaborate on the spectrum of public participation with respect to the SBEADMR planning process.

Public meetings, workshops, a science meeting and a field trip were convened and facilitated by the Public Lands Partnership (PLP)[2] to foster deeper understanding and seek comment into the tools, analysis, issues and options related to the project and the analysis.

The objectives of the first workshop (December 3, 2013 in Montrose, CO) were to develop stakeholder knowledge of the beetle and the infestation; promote learning about the project and beetle; and to develop more public involvement and collaboration. Speakers and talks explained the extent of the infestation; the ecology of the beetle and the paths of expansion of the infestation; introduced and explained the rationale for the SBEADMR project proposal and provided opportunities for further exploration and comment on the issues that were identified during scoping. Resource and science experts were on hand and the meeting was hosted and facilitated by the Public Lands Partnership. Approximately 90 people attended this meeting.

A second day-long workshop/meeting was convened and facilitated by PLP on May 13, 2014, in Montrose, Colorado. The objectives of this workshop were to provide: an overview of the spruce beetle epidemic and sudden aspen decline within the context of the SBEADMR; the basic science and analysis approaches used in the EIS; an overview of the adaptive implementation approach to implement SBEADMR after a decision is made; discuss the responsive actions that were being taken to address issues and concerns identified in the prior meeting; and to discuss the involvement of collaborators/stakeholders during implementation. At this meeting, stakeholders were also provided descriptions of the alternatives that were being developed based on the identified project issues and concerns. Approximately 89 people attended this meeting and stakeholders were again invited to provide peer-reviewed science that they want considered in

[2] The Public Lands Partnership (PLP) was formed in 1992 as an informal forum to address public land issues in west central Colorado via diverse public stakeholder engagement and dialogue.

the project and to provide suggestions/feedback/comment on the tools that were introduced for the project.

As a result of the previous workshops/meetings, stakeholders identified a desire to further explore current science related to the project. The Rocky Mountain Research Station worked to develop a panel of scientific experts from various scientific backgrounds and perspectives to address an array of pertinent science associated with the project. A day-long science workshop was hosted in Montrose, CO, on August 19, 2014. The following science was presented and discussed:

- Balancing the ecology with social and economic values.
- Aspen ecology, values and current condition.
- The combined influence of beetles, fire, blowdown and salvage on regeneration in spruce dominated forests.
- Climate projections, climate effects on disturbance and how management and disturbance may alter forest carbon storage.
- Fire behavior after bark beetles.
- Snow dynamics and watershed response after bark beetles.
- The future landscape and framing objectives.

The science meeting and presentations were professionally video-taped to record the information for reference and to make the information available for other stakeholders who were not able to attend. Approximately 112 people attended.

A public field trip to areas of the Forests that are affected by the spruce beetle was hosted on September 4, 2014. The focus of the field trip was to help stakeholders to see the effects of the infestation on-the-ground and to discuss elements of the previous workshops and the science meeting as it applies to the affected forest. It also provided the opportunity to look at the potential to apply the tools proposed within the project and their potential application to affected stands. 60 stakeholders and 39 Forest Service staff participated in the field trip.

As a result of the public workshops, science meeting and the field trip, additional refinement of the issues and concerns and incorporation of additional science and desired research projects were incorporated into the analysis and documentation for the project.

Recognizing a desire on the part of stakeholders to continue dialogue and potential benefits for further involvement and/or collaborative work, Uncompahgre/Com and PLP offered to convene and facilitate a working group for SBEADMR. The Working Group is its own entity; however, it is facilitated by the Public Lands Partnership as part of their efforts to “bring together varied interests to work on local natural resources issues.” The Working Group met throughout the fall and winter and continues to meet. Stakeholders discussed a variety of topics, and representatives

of the Forest Service have attended to provide technical information regarding the SBEADMR DEIS, forest management and other topics of interest to the Group.

Individuals and groups continued to provide comments to the Forest Service regarding the SBEADMR project throughout the planning process. Although these were submitted outside formal scoping and comment periods, the GMUG considered all public comments within the Draft.

Additionally, the GMUG has entered into an agreement with the Rocky Mountain Research Station and Colorado State University/Colorado Forest Restoration Institute to address science questions and monitoring needs for the project.

There is mutual interest from the public and the GMUG for active public involvement throughout the implementation of any action alternatives for SBEADMR. The proposed framework for such is detailed in *Chapter 2, Adaptive Implementation Approach* and *Appendix E.*

Issues

The following issues were raised by either the public during the scoping period, or by the Interdisciplinary Team (IDT) working on the analysis of potential effects related to the proposed action. The IDT conducted a comment analysis, tracked all comments submitted from the public during scoping, and indicated which concerns should be identified as substantial issues or not, and the reasons for that determination. The IDT reviewed the comment analysis; the comment analysis is part of the project record.

Issues serve to highlight effects or unintended consequences that may occur from the proposed action and alternatives, giving opportunities during the analysis to reduce adverse effects and compare trade-offs for the decisionmaker and public to understand.

The IDT separated issues into two groups: substantial and minor. Substantial issues were defined as those which offer points of debate, or raise unresolved concerns directly or indirectly caused by implementing the proposed action. Substantial issues drove the development of the action alternatives, and focused the scope and extent of the analysis of environmental effects that may occur from implementation of any of the alternatives.

Minor issues were identified as those: 1) outside the scope of the proposed action; 2) already decided by law, regulation, Forest Plan, or other higher level decision; 3) irrelevant to the decision to be made; or 4) conjectural and not supported by scientific or factual evidence. Some of the minor issues helped to focus the scope and extent of the effects analysis, as well. The Council on Environmental Quality (CEQ) NEPA regulations (40 CFR 1500.4(g) and 1501.7) explains that minor issues can be excluded from detailed analysis in Sec. 1501.7, "…identify and

eliminate from detailed study the issues which are not significant or which have been covered by prior environmental review (Sec. 1506.3)…"

The IDT identified the following substantial issues from comments received during the scoping period:

Issue 1. Roads

There were many comments concerning roads and the effects of roads on the natural environment, such as habitat fragmentation, sediment input into streams and riparian areas, decreased water quality, and detrimental effects to soils, vegetation, and wildlife, as well as possibly serving as vectors for increased occurrences of invasive or noxious weeds and non-native plant species. Several respondents stated the proposed project should:

1. Avoid building new roads due to possible impacts to physical resources. Alternative 3 addresses this issue in part by minimizing the building of new roads compared to Alternative 2 and 4. The effects of road construction on physical resources are analyzed in each of the alternatives.
2. Use best management practices to minimize impacts from new roads. This issue is addressed in project design features, *Appendix B.* The effects of implementing best management practices are disclosed in Chapter 3, for each alternative.
3. Close and restore new roads when the roads are no longer needed. This issue is addressed in project design features, *Appendix B.* The effects of closing or restoring any new roads are disclosed in Chapter 3, for each alternative.
4. Limit treatments to infrastructure areas only, thereby limiting the need for new roads. Alternative 3 addresses this issue in part by minimizing the building of new roads compared to Alternative 2 and 4. The effects of limiting treatments to areas with infrastructure are disclosed in Chapter 3.

Issue 2. Effectiveness of Resiliency Treatments and the Need for Treatment

Many respondents expressed their support to limit widespread spruce and fir tree mortality that is caused by the Engelmann spruce bark beetle, and to reduce the impacts of sudden aspen decline by increasing aspen regeneration. However, some respondents were concerned with the effectiveness of resiliency treatments in spruce. Other people raised the philosophical question of whether we should be treating aspen decline at all, stating that aspen decline is a natural process.

Effectiveness of Treatments in Spruce and Aspen Forests

There were several comments that questioned whether the proposed treatments in spruce forests would result in forests that are more resilient to future insect outbreaks, or if treatments in aspen forests would be effective at promoting regeneration in aspen stands. Several respondents stated the proposed project should:

1. Avoid treatments in spruce stands that have not been attacked by the Engelmann spruce bark beetle because resiliency treatments are ineffective and may actually adversely affect the areas treated by exposing stands to increased risk of windthrow and reducing potential and existing regeneration. This substantial issue contributed to the development of Alternative 4, which proposes spruce salvage only. This issue is analyzed for each of the action alternatives. That analysis is in Chapter 3.
2. Consider the likely success of treatments in dying aspen stands. This substantial issue is analyzed for each of the action alternatives. That analysis is in Chapter 3.
3. Only remove dying and dead spruce trees and treat SAD only in infrastructure areas. This substantial issue contributed to the development of Alternative 4, which proposes salvage in dying and dead spruce trees only, and contributed to the development of Alternative 3, which proposes treatment of aspen forests affected by SAD in infrastructure areas only.

Need for Treatments in Aspen Stands

There were several comments that questioned the need for the proposed treatments in aspen forests. Several respondents stated the proposed project should not treat aspen stands at all because SAD is a natural process and no treatments are needed; others stated that aspen decline is a part of natural succession, and no management response is required. Other respondents questioned the need for treatments in aspen stands not affected by SAD. This substantial issue contributed to the development of Alternative 3, and is analyzed for all action alternatives in Chapter 3.

Issue 3. Expanded Treatments to Provide Socioeconomic Benefits

Several respondents commented on the need for the project to support local communities by maximizing mechanical treatments that would produce wood products, in order to contribute to those economies. Some people commented that the potential treatment area needs to be expanded beyond the acreage described in the scoping documents, in order to be truly effective at addressing the large landscape scale of the spruce beetle epidemic. Several respondents stated the proposed project should:

1. Mechanically treat the greatest amount of acres possible in order to gain the maximum reduction in Engelmann spruce beetle and SAD impacts, and to provide the greatest amount of wood products for local industry, thus providing more economic input in local communities. This substantial issue contributed to the development of Alternative 4,

which proposes spruce salvage only. The effects of this issue on the physical and social environment are analyzed and disclosed for all of the alternatives in the effects analysis in Chapter 3.

2. Increase the acreage of the area treated to reduce the amount of untreated land, thus reducing the overall population of beetles feeding into the epidemic's spread. This substantial issue contributed to the development of Alternative 4, spruce salvage only. The effects of this issue on the physical environment are analyzed and disclosed for all of the alternatives in the effects analysis in Chapter 3.
3. Analyze the socioeconomics of proposed commercial timber sales concerning cost/benefits to local economies and reforestation. This significant issue is analyzed for all alternatives in Chapter 3.
4. Analyze timber sale contract provisions that hamper efficient wood products production. This minor issue was not identified as a substantial issue, because it is already determined by other laws, regulations, and policies.

Issue 4. Treat Only for Human Health and Safety Purposes

Several people commented that the potential treatment area described in the scoping document is too large, and should concentrate on areas that need or that would benefit from treatments that would promote public safety. This issue was identified as substantial. It contributed to the development of Alternative 3, which proposes treatments with a focus on public safety. This issue was also integrated into each action alternative. The effects of this issue on the physical and social environment are analyzed and disclosed for all the alternatives in Chapter 3.

Other Related Efforts

The GMUG is currently implementing additional vegetation management treatments that partially overlap with the SBEADMR project area under existing NEPA decisions, including the Cochetopa Hills Vegetation Management Project (2014), Escalante Forest Restoration Project (2013), La Garita Beetle Response (2013), Long Slough (2013), and the Grand Valley Spruce Beetle SAD Treatments (2011). In addition, over the anticipated lifetime of the SBEADMR project, approximately 40-50,000 acres of spruce-fir and aspen vegetation management within the SBEADMR project area are anticipated that would be authorized by other existing and/or future NEPA decisions.

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CHAPTER 2. ALTERNATIVES, INCLUDING THE PROPOSED ACTION

Introduction

This chapter describes and compares the alternatives considered for the Spruce Beetle Epidemic and Sudden Aspen Decline Management Response project. It includes a description and map of each alternative considered. This section also presents the alternatives in comparative form, defining the differences between each alternative and providing a clear basis for choice among options by the decision maker and the public.

Alternatives Considered in Detail

The Forest Service developed four alternatives, including the No Action and Proposed Action alternatives, in response to issues raised by the public during the scoping period.

Alternative 1 (No Action Alternative)

The National Environmental Policy Act (NEPA) requires the study of the No Action Alternative and directs that this alternative be used as a basis for comparing the effects of the Proposed Action and other alternatives.

The No Action Alternatives assumes that no implementation of this proposed action or the other action alternatives would take place within the project area. This alternative represents no attempt to actively respond to the issues, purpose and need for action, or concerns identified during public scoping for this project. There would be no effort to modify existing conditions, unless authorized by other decisions. Other management actions including vegetation management projects are authorized and would likely continue to be authorized within the project area and timeframes analyzed in this EIS. These other projects would proceed under separate NEPA analyses. Other related projects which are currently authorized are noted in Chapter 1 under “Other Related Efforts.”

Activities Common to All Action Alternatives

The following sections provide additional information regarding activities common to all action alternatives.

Scope and Scale of Treatments

On the GMUG approximately 223,000 cumulative acres have experienced spruce beetle mortality and 229,000 acres have experienced Sudden Aspen Decline. Due to budget constraints, the scale of the epidemic, and the magnitude of affected and potentially affected

acres across all terrain of the forest, the Forest Service cannot treat all affected acres. Although landscapes of various extent are analyzed in this EIS to afford flexibility for land managers to respond in real-time to rapidly changing forest conditions, the Forest is proposing and analyzing treatments of a maximum of 120,000 acres, or 4% of the GMUG, in approximately equal proportions between commercial and noncommercial treatments.

Consistent across all action alternatives, a maximum of 120,000 acres of treatment are proposed and analyzed in this DEIS for treatment over the approximately 8-12 year implementation span of the SBEADMR project and within the defined opportunity areas. Of this total, 40-60,000 acres of commercial treatments and 30-60,000 acres of noncommercial treatment are proposed and analyzed, implemented annually in the range of 3-6,000 acres for both noncommercial and commercial treatment categories. Annual acres treated would largely be driven by personnel and budget constraints in the Forest Service. All commercial treatment would occur on lands identified as suitable for timber production as defined by the Forest Plan (GMUG Forest Plan Amendment, 1991, pages F-1-F-7). At the time of the analysis, there is no existing market for aspen; unless a market were to emerge during the implementation timeframe of this project, commercial treatments in aspen would not be likely to occur.

Given the current location and progression of the spruce bark beetle epidemic, the USFS assumes that 80% of spruce treatments within the Gunnison Basin will be to meet recovery goals (salvage) and 20% of spruce treatments within the Gunnison Basin will be to meet resiliency goals. Outside of the Gunnison Basin, spruce treatments will be approximately evenly split between recovery- and resiliency-oriented treatments.

Opportunity Areas Defined

Opportunity areas in SBEADMR are the maximum extent of geographic area analyzed for potential treatments. As noted above, a *subset* of the opportunity area would be treated; treatment maximum analyzed include 120,000 acres (40-60,000 acres of commercial treatments and 30-60,000 acres of noncommercial treatment). Opportunity areas are limited to spruce and aspen forest types outside of Wilderness, Research Natural Areas, Special Interest Areas, Cultural Areas, and National Natural Landmarks. Additionally, Colorado Roadless Areas (CRAs) are not included within the SBEADMR opportunity areas, as limited agency capacity will be applied to conduct active management treatments to less politically controversial areas. Treatments in CRAs would be authorized under separate NEPA processes.

Starting with these basic parameters, each action alternative further delimits opportunity areas based on different management objectives.

Adaptive Implementation Approach

The Forest Service cannot significantly alter the current infestation or rate of decline in spruce stands, but management of associated hazards, economic opportunities, and resilience, as

detailed in the purpose and need, are the core of this project. Nor can it accurately project the ultimate location and scale of eventual beetle activity. To be more responsive to the rapidly changing conditions of spruce and aspen stands across the landscape to achieve the purpose and need, SBEADMR relies on an adaptive implementation framework for defining treatment locations within the analyzed opportunity areas. Treatment design, incorporating additional monitoring questions, reviewing and evaluating the effects of treatments, and adjusting management towards desired conditions and away from undesirable conditions must also be conducted in an adaptive mannger. Public involvement is critical throughout implementation, and is explicitly incorporated into the approach; this is discussed in further detail below and in *Appendix E.*

The adaptive implementation framework defines a) a cycle of decision points and b) an associated toolbox, discussed in further detail below.

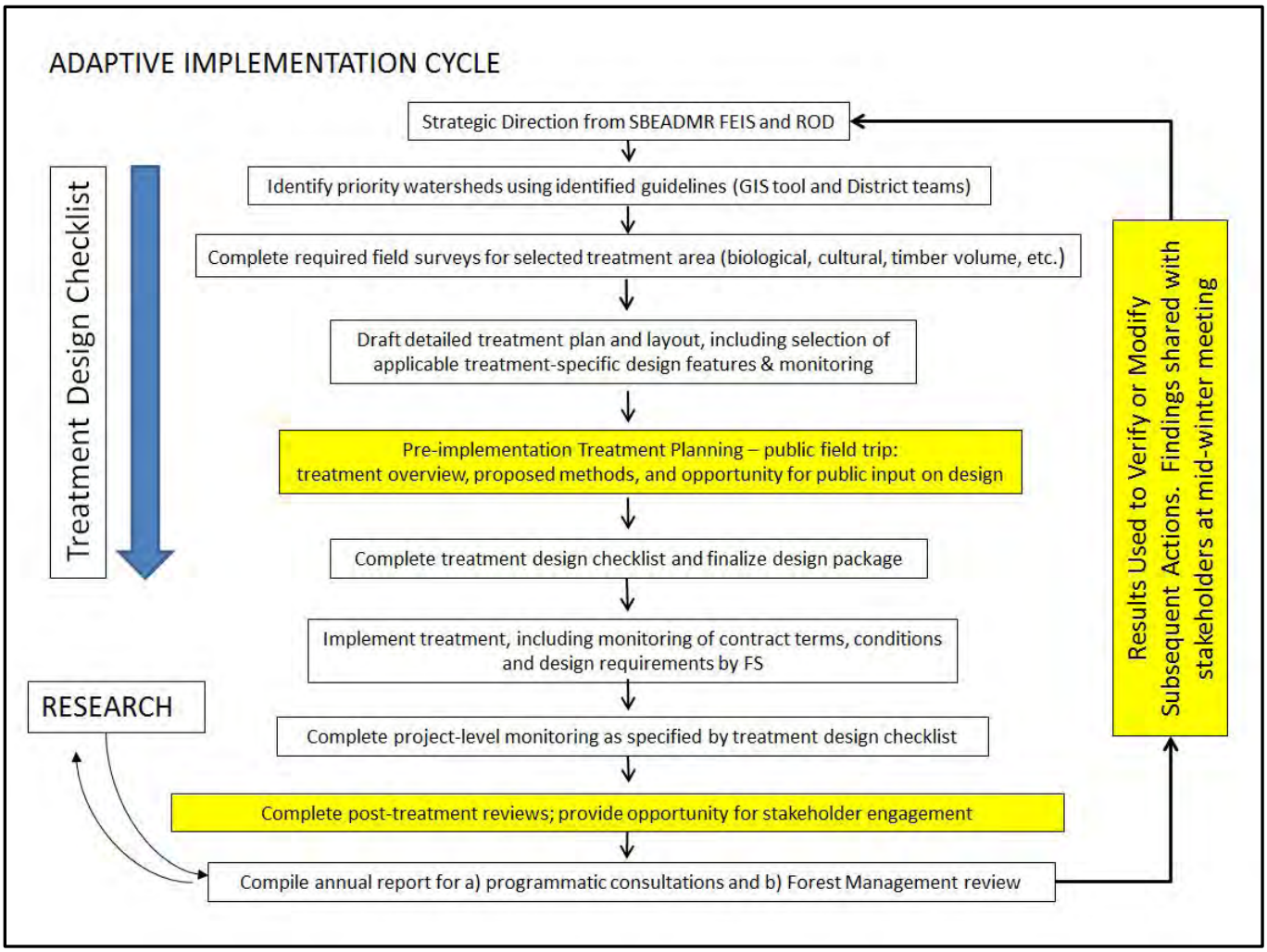


Figure 8. Overview of adaptive implementation cycle. Decision points for stakeholder participation are highlighted in yellow; components of the implementation toolbox are referenced throughout.

Decision Points

The decision points in the adaptive implementation cycle would involve public stakeholders, a science team, and Forest staff. Figure 9 indicates how stakeholders, the Forest Service, and the Science Team will work together to complete all four parts of the Adaptive Implementation Framework.

Decision points for the adaptive implementation will include four major components:

1) Pre-Implementation treatment planning
2) Post-Treatment implementation review focusing on design feature compliance;
3) Annual monitoring review/evaluation and new science summary with stakeholders and science team; and,
4) Annual Management Review.

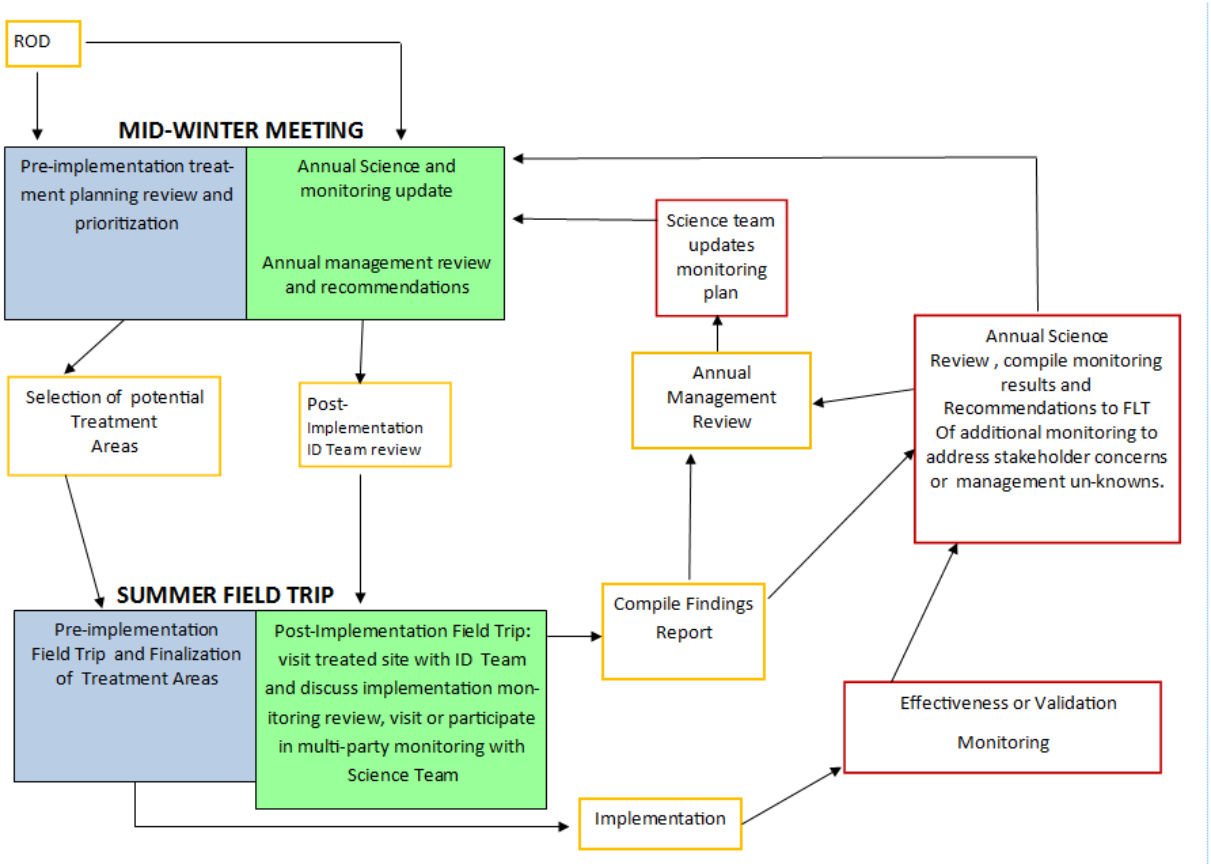


Figure 9. Participatory cycle for SBEADMR implementation: stakeholders, science team, and GMUG FS staff.

In Figure 9, orange boxes indicate actions by the Forest Service. Red boxes indicate actions by the Science Team. Filled boxes indicate stakeholder events; blue would occur prior to a treatment, and green would occur subsequent to a treatment. Stakeholder input is explicitly designed into the implementation process during the mid-winter meeting and summer field trips.

Opportunities for stakeholders to influence implementation would be confined by the sideboards of the selected alternative, as outlined in the Final Record of Decision (ROD) and Environmental Impact Statement (EIS). Further, the Forest Service retains the authority to make final decisions related to location, extent and types of treatments planned and completed consistent with the ROD/EIS. However, if at any-time stakeholders have specific questions or concerns related to any aspect of implementation under SBEADMR, Forest staff would be responsive and take steps to accommodate stakeholder input to the greatest extent practicable. The process outlined here would be required by the ROD and stakeholder involvement will be ongoing throughout the life of the project. See *Appendix E* for further detail.

Implementation Toolbox

The implementation toolbox defines the range of silvicultural and fire prescriptions and design features for treatment implementation and provides a mechanism for monitoring and

documenting compliance. These tools would be used throughout the adapative implementation cycle and the decision points, outlined above. The prescriptions and design features are incorporated into all action alternatives and effects analyses; however, the application of an individual prescription and a suite of design features will depend upon on-the-ground conditions at the time of implementation. These conditions, or triggers for use, are defined in the DEIS.

Most tools are detailed further in an associated referenced appendix. Tools include:

- Guidelines for selection of priority treatment areas – Guidelines developed through stakeholder involvement in 2014 and 2015 would be used by district interdisciplinary teams to identify priority watersheds for treatment. Watersheds will typically range from 10,000 to 40,000 acres in size. Required resource inventories would then be completed and results used to identify treatment areas, identify current vegetative conditions and other factors used to develop a detailed treatment plan(s) for an area. This is further detailed below.
- Silvicultural Prescription Matrix – would be used to identify which and how various stands will be treated to achieve management objectives. Detailed silvicultural prescriptions will be completed by a certified silviculturist by comparing current versus desired vegetative conditions. *See Appendix A.*
- Design Features – would be applied to treatments to minimize or avoid undesirable impacts to resources including, but not limited to, vegetation, soils, water, wildlife and cultural resources. Design Features are incorporated into all action alternatives and their effects analyses. The appropriate design features would be applied when surveys or management activities indicate a need to do so. It is also assumed that design features will be implemented as designed and in a readily visible way, effective. Analysis completed in this document assumes implementation of the appropriate design features *See Appendix B.*
- Pre-Treatment Checklist – tracking tool would document that all required surveys and compliance checks for an individual treatment have been completed. The checklist will also identify design features that would be applied to a particular treatment. For example, the presence of a Northern goshawk nest in a treatment area would trigger the avoidance/protective measures as specified in the design features of the EIS. As such, the checklist would assure treatments are implemented consistent with the EIS. The checklist will also be used to confirm compliance with the Forest Plan. *See Appendix C.*
- Annual Interdisciplinary Team Treatment Review – a monitoring method that provides documentation that treatments are implemented as planned. The treatment review, combined with monitoring results and research findings, is intended to provide feedback to forest managers about how to best design and implement future treatments in the treatment area. The results of this monitoring, in conjunction with best available science, will identify relevant improvements to procedures or exemplary practices to benefit future treatments authorized by the SBEADMR record of decision. *See Appendix D.*

- Public Engagement in Adaptive Implementation – a tool to guide the phases, principles, and activities comprising an adaptive implementation framework for the SBEADMR project. The primary goal is to bring diverse groups and individuals so that they might identify common problems and interests, and creates solutions that will facilitate science-based and stakeholder driven implementation of SBEADMR. *See Appendix E.*

NEPA Sufficiency

In some cases, changed conditions may bring into question whether the scope and range of effects disclosed in this analysis are exceeded. Typically, a change in a design feature to render it more effective to protect resource values or to achieve desired outcomes would remain within the scope and range of the effects analysis. Elimination of a design feature intended to minimize effects would likely be outside range and scope of the analysis. A change in assumptions analyzed in the EIS could also trigger a NEPA sufficiency review. For example, it was assumed that the level of impact to habitat supporting Canada lynx would stay within Forest-level caps identified in the Southern Rockies Lynx Amendment (SRLA). These caps would be tracked over the life of the treatment, and if tracking indicates a pending exceedance in any given year, no additional treatment would be permitted until it is re-analyzed and additional consultation with Fish and Wildlife Service was completed. Substantive changes would require the Forest to undertake an interdisciplinary review of the sufficiency of the NEPA documentation prepared for this treatment. The review may show the information in the original decision is still valid, and is not in need of correction or supplement. However, if that review reveals a need for a correction, supplement or revision to the original decision, then the specific process to correct, supplement, or revise the analysis would be used, as specified in FSH 1909.15(18.2).

Selection of Priority Watersheds for Treatment

To maximize the effectiveness of treatments to address public safety concerns and complete resiliency and recovery in an environmentally sensitive manner, priority watersheds would be determined. In most cases, watersheds ranging from 10,000 to 40,000 acres in size would be prioritized. Through partnership with the Rocky Mountain Research Station and Colorado State University, guidelines would be used to develop a GIS-based tool to assist with identification of such watersheds. The following guidelines would be used to determine priority watersheds for treatment:

- Public safety – Focus treatments in watersheds where roads and other infrastructure exist.
- Ecology – Based upon best available information, identify areas where spruce and aspen ecology have changed most over time due to human and natural disturbances. The GMUG completed five geographic assessments (Grand Mesa, North Fork, Gunnison Basin, San Juans and Uncompahgre Plateau) that describe current and reference condition for spruce-fir and aspen ecosystems. These documents would be utilized where applicable.

- Time since mortality - Engelmann spruce typically die within a year of beetle infestation. Once dead, trees remain merchantable for about 3-5 years. Furthermore, the fuel characteristics change based on time since mortality. Highest priority recovery (salvage) would be those experiencing recent mortality.
- Climate change projections – Aspen and spruce habitats have been classified into *Lost, Threatened, Persistent,* and *Emergent* categories, based on changes anticipated by 2060 (See Chapter 1).
    - Except in particularly moist sites, management in the "lost" habitat zone may be limited to shorter-term benefits, since spruce and aspen persistence in these zones are not currently modeled to persist beyond 2060. Generally, "lost" habitat would be avoided for treatments to meet resiliency goals, unless shorter-term benefits are identified.
    - Most resiliency treatments would target the threatened and persistent habitat zones, following climate-based seed transfer guidelines where possible. Management would consider whether reduction of basal area and density is feasible to increase drought resilience.
    - Consider treatments designed to facilitate or assist migration into Emergent zones.
- Existing transportation system – areas having an existing transportation system adequate to facilitate removal and hauling of logs would be a priority for commercial harvest. Construction of new roads is costly and results in increased environmental impacts.
- Economic viability of treatments – Takes into account haul distances, layout costs, miles and type of roads needing to be constructed, and timber volume per acre.
- Site productivity – areas with the best tree growth. These sites have the highest tree volume per acre and the greatest potential for regeneration and/or tree planting success.
- Wildlife – areas important to various wildlife species (elk calving areas, security areas, etc.) would be avoided or special management considerations would be applied. Typically special management considerations would be in the form of design features.
- Achievement of multiple resource management objectives – watersheds where resource management objectives for wildlife, watershed, fire and timber can be achieved.

Spruce Recovery and Resiliency

The spruce recovery goals would be met through removal of dead and dying trees followed by tree planting where adequate natural seed sources are lacking. As detailed in the silvicultural prescription matrix (*Appendix A*), recovery treatments would retain advanced regeneration and green trees to the extent possible.

Resiliency goals in spruce stands would be met by removal of single trees or group selections of trees where bark beetle impacts are light or in areas yet unaffected by beetles. Removal would emphasize dead and dying stands, with the same considerations for retention of advanced regeneration as noted above. Resiliency treatments are designed to mimic natural gap dynamics

that maintain or encourage multi-storied attributes in accordance with the Southern Rockies Lynx Amendment. Resiliency treatments can also include sanitation treatments to remove pockets of dead and dying trees to reduce the threat of beetle infestation to surrounding healthy stands.

Aspen Resiliency

Aspen and spruce/aspen treatments would consist of coppice cutting, prescribed fire or removal of single spruce or groups of spruce within a stand dominated by aspen. The treatment goal is to regenerate or maintain aspen. Associated soil disturbance may provide sites for aspen regeneration from seed. Coppice cuts of greater than 40 acres in size are intended, as browsing herbivores can severely reduce successful aspen regeneration if coppice cuts are too small in overall area. The adaptive implementation process and additional science on this topic would be used to inform how large treatments should be. Efforts would be made to prioritize treatments based upon likelihood of aspen persistence, given climate projections and current modeled future distribution by elevation (Refeldt et al. 2015).

Treatments

Protection of People and Community Infrastructure

All action alternatives would include treatments to increase the protection of people, communities, and infrastructure by:

- Removal of hazard trees;
- Increasing the extent of defensible space around values at risk;
- Providing safer locations from which firefighters can initiate fire management actions.

Treatments to protect people, communities, and infrastructure would occur:

- In spruce, aspen, and spruce/aspen mix within the WUI, defined as one mile from communities, developed sites, administrative facilities, and within ski area boundaries.
- Hazard tree removal – spruce and aspen and incidental other species within a 300 foot buffer (600 feet total) of infrastructure, including:
    - Roads open to the public
    - Campgrounds and other administrative facilities (approximately 160 facilities)
    - Dispersed recreation sites
    - Developed campgrounds and recreation sites
    - Within Western Area Power Administration (WAPA) and Tri-State power transmission lines rights-of–way and border zones
    - Aboveground electrical power and telephone line corridors
    - Communication sites, water, pipeline, and other utility corridors

The 300-foot (600 feet total) buffer coincides with travel management plans on the GMUG. Currently, dispersed camping is allowed within 300 feet either side of the road. Allowance for

removal of hazard trees will allow removal of trees in frequently used dispersed campsites. Furthermore, the buffer allows for removal of hazard trees on steep slopes above roadways and additional infrastructure. In most cases, hazard trees would be removed if they are within a perimeter around identified infrastructure defined by the average tree height plus 20%.

Mechanical Treatments

- Commercial treatments would occur in lands identified in the 1991 GMUG LRMP as suitable for timber production by the 1991 Forest Plan Amendment (USDA Forest Service, 1991, Appendix F). During treatment reconnaissance and layout, Forest Service personnel would make a *final* determination of suitability. Generally, areas excluded from treatment include:
    - low productivity sites
    - steep slopes (>40%)
    - sites where irreversible damage could occur
    - visually sensitive areas

- Most tree removal would be accomplished using a variety of contracting methods including commercial timber harvest, service contracts, and stewardship contracts or, to a lesser extent, Forest Service work crews or cooperators would be used to thin trees and reduce fuels in areas where contracting is not feasible.

- Non-commercial mechanical treatment methods would include cut and chunk, chipping, hand-cut pile-burn, cut-equipment pile-burn, and coppice cuts (in aspen). Generally chipping and cut-equipment pile-burn would be in areas adjacent to or along private property and roads. Mechanical treatment on slopes greater than 40% in such areas would be limited to chainsaws.

- Mechanical mastication may be used to treat understory fuels by grinding or chipping of vegetation and spreading fragments evenly throughout the treatment unit.

- All commercial mechanical treatments and non-commercial mechanical treatments involving large equipment would occur on slopes less than 40%. For slopes greater than 40%, mechanical treatments would be limited to chainsaws.

- Openings from mechanical treatments in affected stands may exceed 40 acres. Per the 1991 GMUG Amended Forest Plan, the maximum size of openings creating by the application of even-aged silviculture is 40 acres (p. III-43); however, larger openings are permitted when the result of natural catastrophic conditions, such as insect or disease attack. Per the National Forest Management Act, Forest Plan maximum size for openings to be cut in one harvest operation shall not apply to the size of openings harvested as a result of natural catastrophic conditions such as fire, insect and disease attack, or windstorm (16 U.S.C. 1604(g)(3)(F)(iv)).

Prescribed Fire Treatments

- Prescribed fire treatments include broadcast burning and pile burning.
- Broadcast burning will be accomplished with aerial or hand ignitions. Individual burn units may range in size from 500-2000 acres.
- Most broadcast burning will occur in areas with an aspen component.
- Pile burning will generally occur in conjunction with other, mechanical treatments to remove fuels created by the treatment. Piles may be either created at landings or may be constructed throughout treatment units.
- Any treatments that have prescribed fire as a component, whether broadcast or pile burning, will have a Burn Plan developed for them. Burn Plans are required by agency policy and are guided by the FS Manual 5140 as well as the Interagency Prescribed Fire Planning and Implementation Procedures Guide (April 2014). Burn Plans are approved by the Agency Administrator (Forest Supervisor or District Ranger) and contain treatment-specific requirements regarding fuels, topography, and weather conditions under which the burn can be ignited, as well as required fire behavior to meet both the desired objectives and to maintain control of the burn. Burn Plans also contain burn objectives, complexity analysis, size and type of management organization, contingency plans, safety issues and associated mitigations, ignition and holding plans, and smoke management considerations. Additionally, a Smoke Permit from the State of Colorado, Department of Environmental Health, Air Pollution Control Division, would be obtained for any prescribed burn. The Smoke Permit contains 'permit conditions' under which the burn must be ignited; these include maximum daily acres, wind direction, dispersion index, daily ignition cutoff times, and mitigation measures related to smoke management.

Access

Primarily the existing road network would be used to access the proposed treatments and to remove forest products. Existing roads would be supplemented by constructing new temporary and/or designed roads only when necessary; criteria are indicated below. Where necessary for resource protection, existing roads would be reconstructed. Per Forest direction, there would be no increase in open road density. A maximum projection of potential miles of roads needed are a combination of new and reconstructed roads, and are quantified under each action alternative.

The management of project roads would be addressed through the use of design features.

Road Maintenance

All roads would be maintained to Forest Service road infrastructure standards (road surfacing, drainage, etc). The following section references operational maintenance levels, a classification

system for National Forest System Route (NFSRs) which describes the standard to which a road is currently managed. Operational maintenance levels are defined on a scale of 1-5 as described in Table 6.

Table 6. Road Maintenance Levels (Ruiz 2005)

Road Maintenance Level	Description
1	Closed except for intermittent service use
2	High-clearance vehicles, discourage passenger cars
3	Low-speed, single-lane with turnouts, low priority for comfort
4	Moderate degree of user comfort; double- or single-lane, aggregate
5	High degree of user comfort; double-lane, paved

Roads being used for the project that are in good condition would be maintained during the project implementation. Maintenance preserves the function of the road but generally does not include improvements. Maintenance activities generally include: blading; brushing; removal of roadside hazard trees; repair and/or replacement of road surfaces; cleaning, repair, or installation of drainage structures such as culverts, ditches, and dips; dust abatement; removal and installation of closure barriers, and installation or repair of signs. Maintenance activities generally do not disturb ground outside the existing roadway (toe of fill to top of cut) other than removal of material around culvert inlets and cleaning of outlet ditches. NFSRs with operational maintenance levels 1-5 will receive maintenance commensurate with their level of use.

Road Reconstruction

Reconstruction generally includes work to improve and restore roads, or to bring them back up to the original design standard. Improvements would provide for serviceability for project haul vehicles, as well as for proper hydrologic function and stream protection in accordance with applicable Best Management Practices. Actions can include surface improvement; construction of drainage dips, culverts, riprap fills or other drainage or stabilization features with potential disturbance outside the established roadway (toe of fill to top of cut); realignment; and widening of curves as needed for log trucks and chip van passage. Reconstruction also includes the actions included in the Maintenance category, including removal of roadside hazard trees. It is assumed that a majority of lower standard system roads (operational maintenance levels 1-2) used for project access and forest product removal would receive reconstruction or receive required maintenance commensurate with use.

Reconstruction includes the replacement of unsustainable existing roads with new, designed roads.

Road Construction

SBEADMR implementation would emphasize use of existing roads. If existing roads do not meet needs for project implementation, the criteria for constructing additional roads include:

- Longer-term access is needed for stand-tending and fire suppression activities.
- Skid distances are greater than ¼ mile (would apply for temporary or low standard designed road).
- Existing road that is needed for management actions are having unacceptable resource impacts (soils and water, wildlife, etc.).
- As required by Forest Service Handbook 7709.56 and other applicable Forest Service Manuals and Handbooks.

During treatment implementation, an analysis and determination would be made for each proposed new road as to whether the route should be a) "designed" or b) temporary.

Designed Roads- These roads would be designed to engineering standards and formal specifications. Expected actions for designed roads include vegetation clearing, excavation and embankment, blading and shaping, installation of drainage structures, and importing of armoring and surfacing rock material as needed. Criteria for constructing designed roads (vs temporary) include the presence of adjacent resource concerns (perennial and intermittent stream crossings, high soil erosion hazard, steeper side slopes, etc.).

Relocated Roads - When an existing system road needed for SBEADMR implementation is having an unacceptable resource impact (e.g. located within an active floodplain), SBEADMR implementation may include relocating the existing road to a less impactful location. In such cases, the new designed road would be retained, as the new road would replace an original part of the Forest transportation system.

Temporary Roads - Criteria for constructing temporary roads (vs designed) include: intended for short-term use; minimal resource concerns exist. These are low-standard roads over gentle terrain. Construction of new temporary roads would include vegetation clearing, excavation, blading and shaping. Existing temporary roads would be reconstructed as necessary to provide for safe project access and removal of forest products. Temporary roads would be improved as necessary to attain stabilization of the roadbed and fill slopes, including employing measures such as out-sloping, drainage dips, and water-spreading ditches. Unlike permanent roads, temporary roads would only have the minimal investment and drainage required to minimize resource impacts while providing for safe use and passage of haul vehicles during the short life of the route.

Road Decommissioning

The GMUG anticipates decommissioning all designed roads post-project implementation, but may retain a limited number of designed roads for longer-term use. All temporary roads constructed would be decommissioned post-project implementation.

Decommissioning involves removing bridges and culverts, eliminating ditches, out-sloping the roadbed, contouring to re-establish the natural undisturbed slope, scarifying of the road surface to reduce compaction, promoting native vegetation, removing ruts and berms, effectively blocking the road to normal vehicular traffic where feasible under existing terrain conditions, and building cross ditches and water bars. When bridges and culverts are removed, associated fills shall also be removed to the extent necessary to permit normal maximum flow of water and reconstruction of the floodplain and stream channel as needed.

Right-of-way Acquisition

Some roads under private jurisdiction may provide more efficient access to the project. These roads would require a Forest Service right-of-way or access agreement to allow for access and haul of forest products. Where appropriate, public easements would be pursued; at a minimum administrative access would be needed for project use.

Encroachment of Other Public Roads

Vegetation treatments along and adjacent to county- and State-managed public roads are included in the action alternatives. Use of existing NFSRs and intersections that connect to these public routes is preferred. Where SBEADMR implementation efforts could potentially interfere with traffic or operations of these public roads, coordination with the applicable agency is necessary. This includes construction of new intersections and access aprons that would tie into existing public roads. Coordination would address signing and traffic control, permitting, alignment, and construction standards necessary for new aprons and intersections, at a minimum.

Connected Actions Related to Roads

Available water and rock material sources within and adjacent to the treatment area would be utilized to support project road work. Roads providing access to and from these sites would also be maintained, and reconstructed when applicable.

Alternative 2 (Proposed Action)

Size and Geographic Location of Treatments

As noted above in *Activities Common to All Action Alternatives,* the proposed action analyzes an opportunity area, of which a *subset* would be treated. Maximum commercial *treatments* under this and all action alternatives total 60,000 acres; maximum noncommercial treatments another 60,000 acres, for a total of 120,000 maximum treated acres.

The total Alternative 2 opportunity area is 718,000 acres where commercial and non-commercial mechanical and prescribed fire treatments could be implemented (See

Figure 10). Treatments could occur anywhere in spruce, aspen, and spruce/aspen mix vegetation types on the GMUG within this opportunity area. This is the maximum extent of opportunity area for Alternative 2, yet opportunities for commercial and non-commercial treatment have distinct spatial parameters within this opportunity area. Outside of the public safety areas, commercial treatments would only occur within 24 identified Lynx Analysis Units (LAUs) on lands identified as suitable timber, comprising an area of 278,000 acres (See

Figure 11).[3] Of these 278,000 acres commercial opportunity acres, 99,000 acres are identified as spruce; 97,000 acres as aspen; and 82,000 acres as aspen-spruce mix. (See Table 10 for acreage breakdowns by species.) As noted above, commercial aspen treatments are not likely due to the lack of an aspen market at the time of this writing.

Non-commercial treatments would occur *outside* suitable lynx habitat, with the exception of hazard tree treatments proximal to infrastructure and fuel treatments within 200 feet of infrastructure.

[3] Approximately 80% of the spruce-fir identified as suitable for timber production occurs within the 24 LAUs, making this a cost-effective area to analyze and commercially treat. These LAUs also contain spruce stands with the highest level of current beetle activity or areas anticipated to be affected in the foreseeable future.

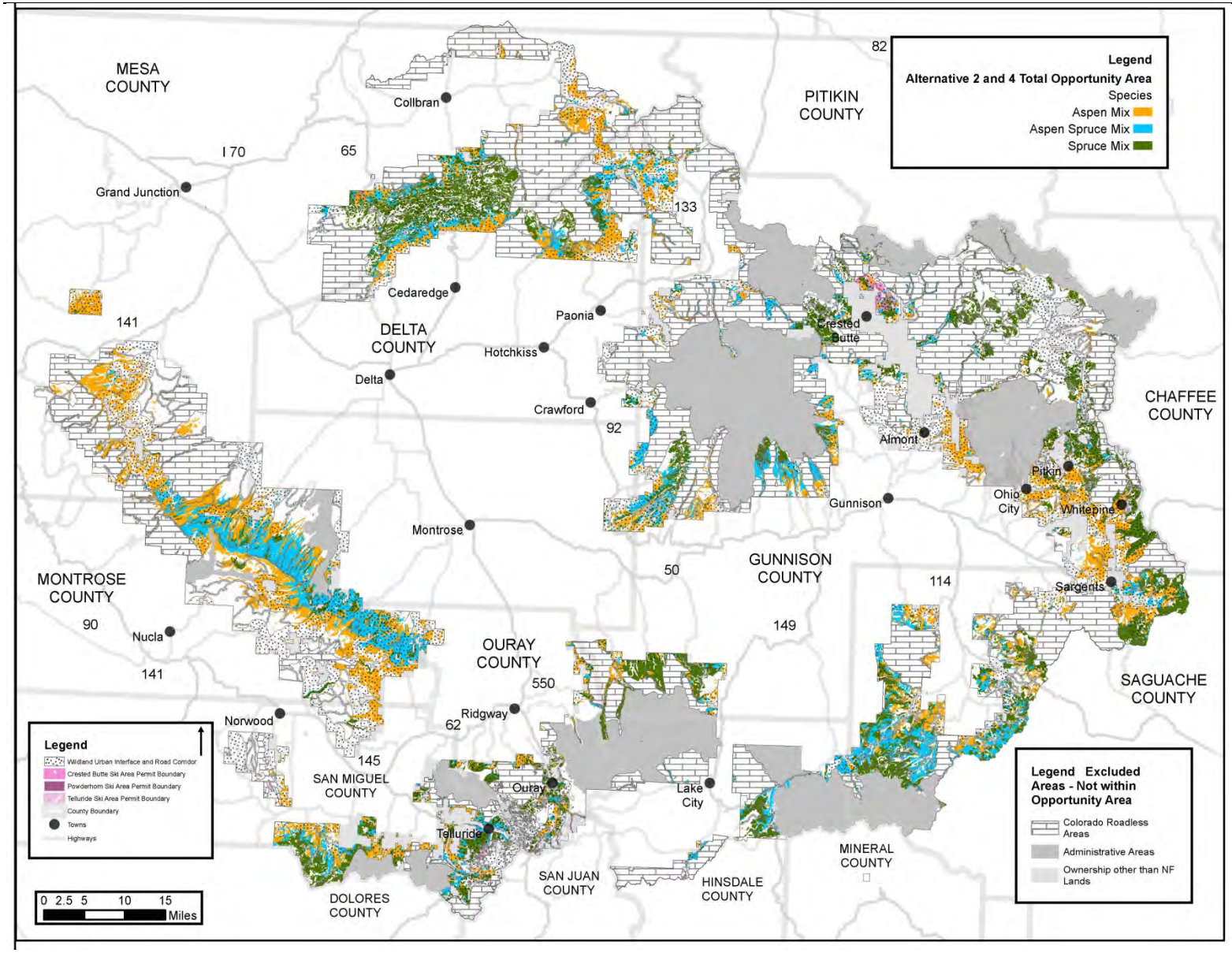


Figure 10. Alternatives 2 and 4 total opportunity areas.

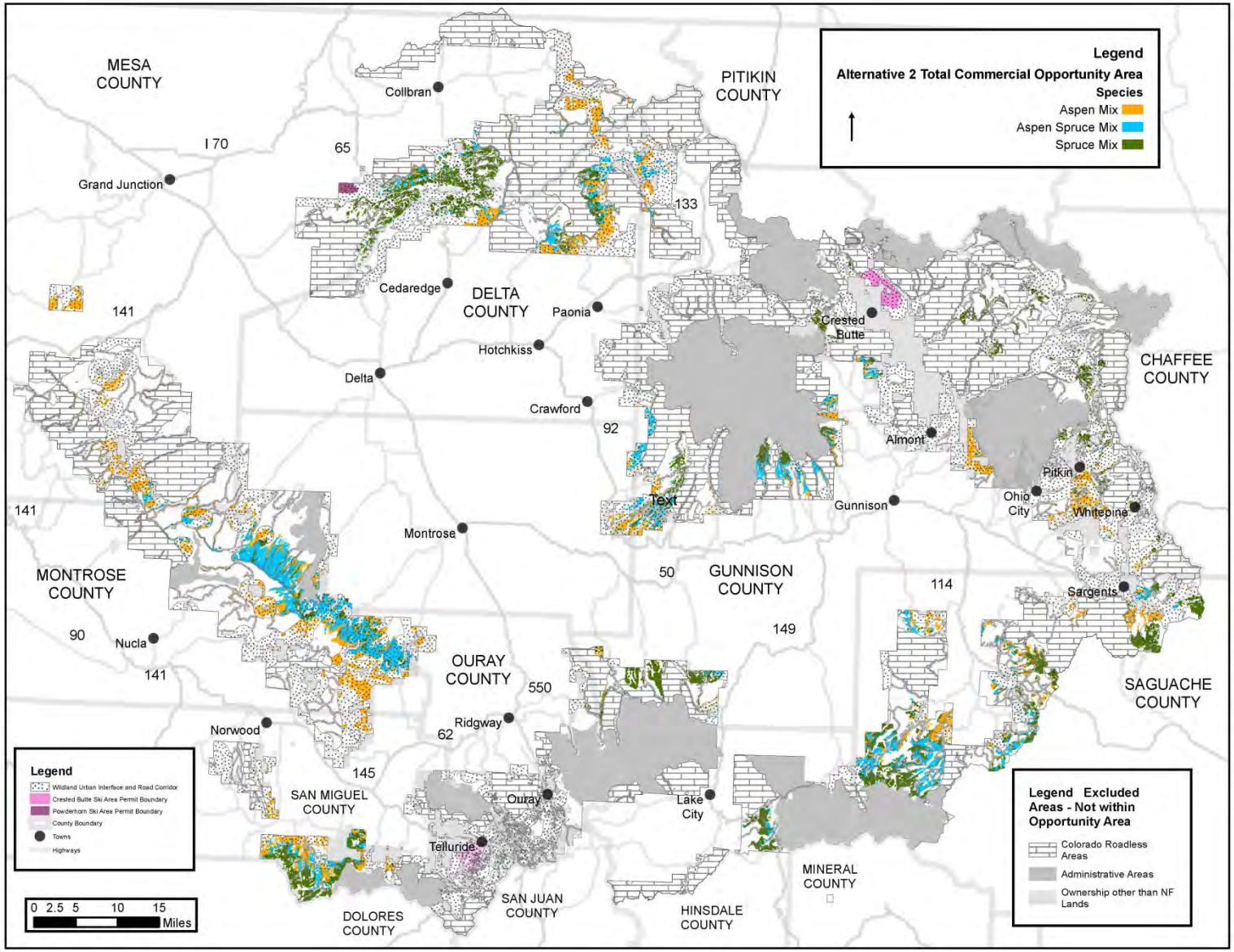


Figure 11. Alternative 2 total commercial opportunity areas.

Aspen Treatments

Aspen and spruce/aspen treatments would consist of coppice cutting, prescribed fire or removal of single spruce or groups of spruce within a stand dominated by aspen. The goal of the treatments is to regenerate or maintain aspen. Associated soil disturbance may provide sites for aspen regeneration from seed. Coppice cuts greater than 40 acres in size are intended, as browsing herbivores can severely reduce successful aspen regeneration if coppice cuts are too small in overall area. The adaptive implementation process and additional science on this topic will be used to inform how large treatments should be. Efforts would be made to prioritize treatments based upon likelihood of aspen persistence, given climate projections and current modeled future distribution by elevation (Refeldt et al. 2015).

Spruce Treatments

The spruce recovery goals would be met through removal of dead and dying trees followed by tree planting where adequate natural seed sources are lacking and when funds are available to do so.

Resiliency goals in spruce stands would be met by removal of single trees or group selections of trees where bark beetle impacts are light or in areas yet unaffected by beetles. Resiliency treatments are designed to mimic natural gap dynamics that maintain or encourage multi-storied attributes in accordance with the Southern Rockies Lynx Amendment. Resiliency treatments can also include sanitation treatments to remove pockets of dead and dying trees to reduce the threat of beetle infestation to surrounding healthy stands.

Aspen-Spruce Mix Treatments

Aspen and spruce/aspen treatments would consist of coppice cutting, prescribed fire or removal of single spruce or groups of spruce within a stand dominated by aspen. The treatment objective is to regenerate or maintain aspen. Associated soil disturbance may provide sites for aspen regeneration from seed. Coppice cuts greater than 40 acres in size are intended, as browsing herbivores can severely reduce successful aspen regeneration if coppice cuts are too small in overall area. The adaptive implementation process and additional science on this topic will be used to inform how large treatments should be. Efforts would be made to prioritize treatments based upon likelihood of aspen persistence, given climate projections and current modeled future distribution by elevation (Worrall et al, in review).

Access

In order to access proposed treatments and remove forest products, Alternative 2 may include the following maximum estimated roadwork. These represent maximum anticipated miles that may be constructed and maintained under this alternative, and are based on the maximum acreage analyzed for commercial treatment in Alternative 2. Designed, temporary, and reconstruction miles are a maximum estimate in the event that all roads for each commercial treatment would

need to be constructed/reconstructed. This roadwork would be conducted in accordance with the descriptions provided above (See *Activities Common to All Action Alternatives / Access).*

Table 7. Alternative 2 Road Treatments

Roadwork Activity	Miles
Designed Road Construction	60
Designed Road Decommissioning[1]	(48)
Temporary Road Construction	260
Temporary Road Decommissioning[2]	(260)
Road Reconstruction	260
Maximum Additional Roads in long-term[1]	**12**
Road Maintenance	
Operational Maintenance Level 5	4
Operational Maintenance Level 4	120
Operational Maintenance Level 3	230
Operational Maintenance Level 2	80
Operational Maintenance Level 1	10
Total Maintenance Miles[3]	**444**

[1] For purposes of analysis, the assumption is that at least 80% of designed roads constructed in SBEADMR would be decommissioned. The GMUG anticipates decommissioning most, if not all, designed roads constructed roads for this project.
[2] 100% of temporary roads constructed in SBEAMDR would be decommissioned
[3] Some of the identified maintenance would overlap with the miles of potential reconstruction and construction identified in Table 7. Other maintenance would occur on additional, currently existing roads.

Alternative 3 (Public Safety Focus)

In order to maximize safety of people and community infrastructure, Alternative 3 shifts the geographic extent of treatments exclusively to 1) the wildland urban interface (WUI) and 2) outside the WUI, proximal to additional human infrastructure (See 'Protection of People and Community Infrastructure', *Activities Common to All Alternatives*). This alternative was developed to address public comments that proposed that treatments focus on public safety purposes, rather than using active management on the larger landscape to address the bark beetle infestation and SAD.

All treatment types and methods would remain the same as in Alternative 2, but would be limited to the identified opportunity area.

Size and Geographic Location of Treatments

As noted above in *Activities Common to All Action Alternatives,* Alternative 3 analyzes an opportunity area, of which a subset would be treated. Maximum commercial treatments under

this and all action alternatives total 60,000 acres; maximum noncommercial treatments another 60,000 acres, for a total of 120,000 maximum treated acres.

The total Alternative 3 opportunity area covers 426,000 acres (See Figure 12). Opportunities for commercial treatments would be limited to the 164,000 acres of suitable timber in the WUI and roadside corridors (See Figure 13). Of these 164,000 acres commercial opportunity acres, 45,000 acres are identified as spruce; 76,000 acres as aspen; and 42,000 acres as aspen-spruce mix (See Table 10 for acreage breakdowns by species). As noted above, commercial aspen treatments are not likely due to the lack of an aspen market at the time of this writing.

Aspen Treatments

All treatment types and methods would remain the same as in Alternative 2, but would be limited to the identified opportunity area.

Spruce Treatments

All treatment types and methods would remain the same as in Alternative 2, but would be limited to the identified opportunity area.

Aspen-Spruce Mix Treatments

All treatment types and methods would remain the same as in Alternative 2, but would be limited to the identified opportunity area.

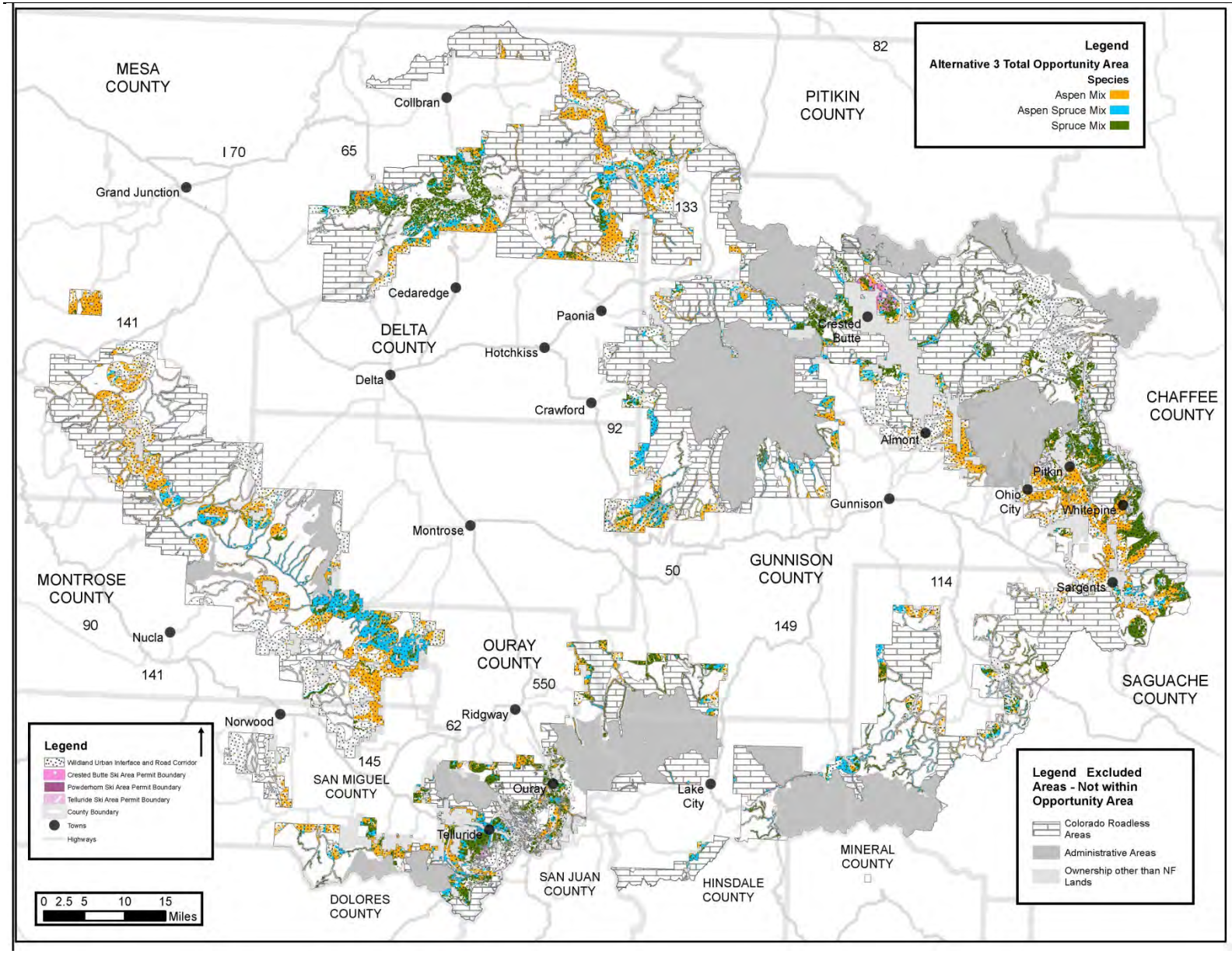


Figure 12. Alternative 3 total opportunity area.

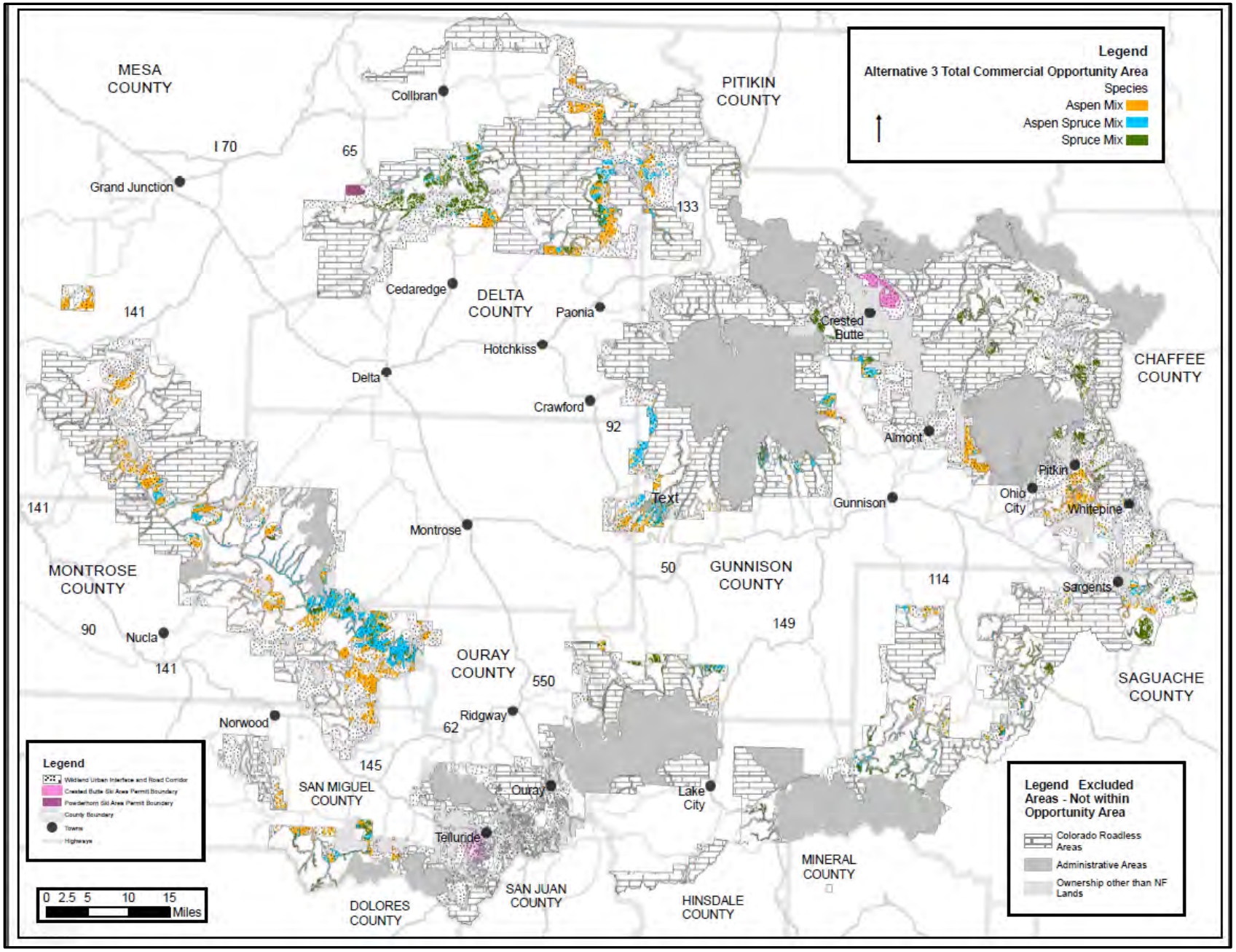


Figure 13. Alternative 3 total commercial opportunity area.

Access

In order to access proposed treatments and remove forest products, Alternative 3 may include the following estimated roadwork. These represent maximum anticipated miles that may be constructed and maintained under this alternative, and are based on the maximum acreage analyzed for commercial treatment in Alternative 3. Designed, temporary, and reconstruction miles are a maximum estimate in the event that all roads for each commercial treatment would need to be constructed/reconstructed. This roadwork would be conducted in accordance with the descriptions provided above (See *Activities Common to All Action Alternatives / Access).*

Table 8. Alternative 3 Road Treatments

Roadwork Activity	Miles
Designed Road Construction	10
Designed Road Decommissioning[1]	(8)
Temporary Road Construction	70
Temporary Road Decommissioning[2]	70
Road Reconstruction	260
Maximum Additional Roads in long-term[1]	**2**
Road Maintenance	
Operational Maintenance Level 5	6
Operational Maintenance Level 4	180
Operational Maintenance Level 3	350
Operational Maintenance Level 2	90
Operational Maintenance Level 1	10
Total Maintenance Miles[3]	**646**

[1] For purposes of analysis, the assumption is that at least 80% of designed roads constructed in SBEADMR would be decommissioned. The GMUG anticipates decommissioning most, if not all, designed roads constructed roads for this project.
[2] 100% of temporary roads constructed in SBEAMDR would be decommissioned
[3] Some of the identified maintenance would overlap with the miles of potential reconstruction and construction identified in Table 8. Other maintenance would occur on additional, currently existing roads

Alternative 4 (Spruce Salvage)

Alternative 4 excludes green-stand spruce treatments to meet resiliency goals and expands the area available to meet recovery goals for commercial harvest. This alternative addresses scoping comments that stated that green-stand resiliency treatments in spruce are ineffective, and that the Forest Service should maximize opportunities to salvage merchantable spruce across the planning area. Treatments would occur in the same geographic areas as Alternative 2, except commercial mechanical treatments would also occur in areas outside the 24 focus LAUs on suitable timber lands in aspen, spruce or aspen/spruce mix, in accordance with the requirements

in the Southern Rockies Lynx amendment, resulting in an additional 50,000 acres available for commercial treatment opportunities relative to Alternative 2.

Size and Geographic Location of Treatments

As noted above in *Activities Common to All Action Alternatives,* Alternative 4 analyzes an opportunity area, of which a subset would be treated. Maximum commercial treatments under this and all action alternatives total 60,000 acres; maximum noncommercial treatments another 60,000 acres, for a total of 120,000 maximum treated acres.

Treatments would occur in the same geographic areas as Alternative 2, except commercial mechanical treatments would also occur in areas outside the 24 focus LAUs on suitable timber lands in aspen, spruce or aspen/spruce mix, resulting in an additional 55,000 acres available for commercial treatment opportunities relative to Alternative 2. The total opportunity area encompasses 718,000 acres (See Figure 10). Opportunities for commercial treatments would be limited to the 323,000 acres of suitable timber within the total area (See Figure 14). Of these 323,000 acres commercial opportunity acres, 115,000 acres are identified as spruce; 121,000 acres as aspen; and 88,000 acres as aspen-spruce mix (See Table 10 for acreage breakdowns by species). As noted above, commercial aspen treatments are not likely due to the lack of an aspen market at the time of this writing.

Aspen Treatments

Aspen treatments would be the same as described in Alternative 2.

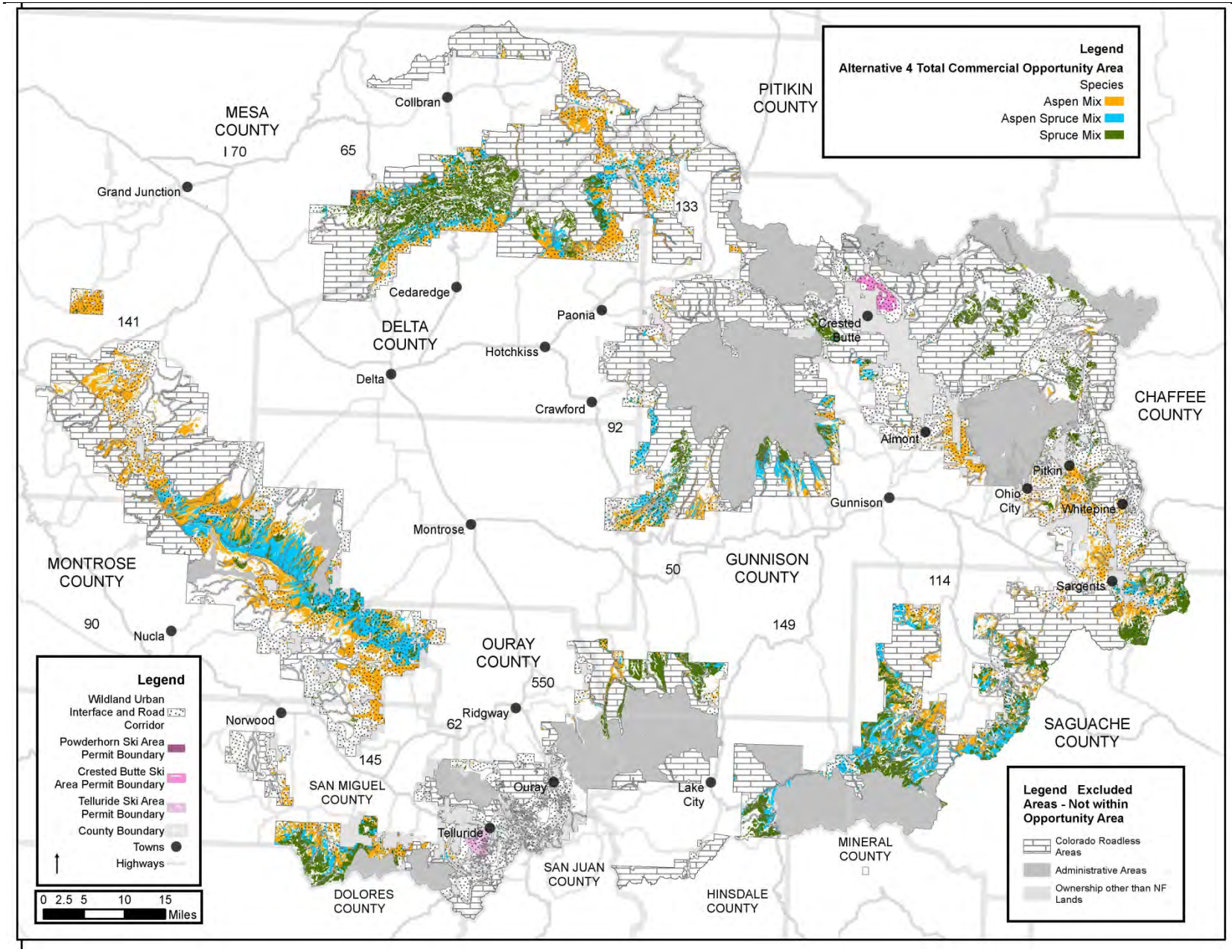


Figure 14. Alternative 4 total commercial opportunity areas.

Spruce Treatments

In this alternative, only spruce stands that have been affected by spruce bark beetle would be treated to meet recovery goals and to increase the resilience of neighboring green stands (via sanitation harvest). No green-stand treatments would occur to create multi-storied stand conditions in spruce. All other treatment types, methods and target acres would remain the same as described in Alternative 2.

Aspen-Spruce Mix Treatments

Aspen-spruce mix treatments would be the same as described in Alternative 2.

Access

In order to access proposed treatments and remove forest products, Alternative 4 may include the following estimated roadwork. These represent maximum anticipated miles that may be constructed and maintained under this alternative, and are based on the maximum acreage analyzed for commercial treatment in Alternative 4. Designed, temporary, and reconstruction miles are a maximum estimate in the event that all roads for each commercial treatment would need to be constructed/reconstructed. This roadwork would be conducted in accordance with the descriptions provided above (See *Activities Common to All Action Alternatives Access).*

Table 9. Alternative 4 Road Treatments

Roadwork Activity	Miles
Designed Road Construction	60
Designed Road Decommissioning[1]	(48)
Temporary Road Construction	260
Temporary Road Decommissioning[2]	(260)
Road Reconstruction	260
Maximum Additional Roads in long-term[1]	**2**
Road Maintenance	
Operational Maintenance Level 5	4
Operational Maintenance Level 4	120
Operational Maintenance Level 3	230
Operational Maintenance Level 2	80
Operational Maintenance Level 1	10
Total Maintenance Miles[3]	**444**

[1] For purposes of analysis, the assumption is that at least 80% of designed roads constructed in SBEADMR would be decommissioned. The GMUG anticipates decommissioning most, if not all, designed roads constructed roads for this project.
[2] 100% of temporary roads constructed in SBEAMDR would be decommissioned
[3] Some of the identified maintenance would overlap with the miles of potential reconstruction and construction identified in

Table 9. Other maintenance would occur on additional, currently existing roads.

Summary of Alternatives

Table 10 provides a summary of the opportunity area analyzed for each action alternative and significant features of each alternative. The total opportunity area is represented in a variety of different subset breakouts.

Table 10. Summary of Alternatives.

Description	Alternative 1 No Action	Alternative 2 Proposed Action	Alternative 3 Public Safety Focus	Alternative 4 Spruce Salvage
Opportunity Areas (acres)				
Total Opportunity Area (OA) [1]	**0**	**718,000 acres**	**426,000 acres**	**718,000 acres**
Subsets of the Total Opportunity Area, commercial and noncommercial categories				
Commercial opportunity area (can include noncommercial treatments)	0	278,000 acres (39% of total OA)	164,000 acres (38% of total OA)	323,000 acres (45% of total OA)
Limited to noncommercial, slopes >40% (limited to prescribed burns and hand	0	132,000 acres (18% of total OA)	101,000 acres (24% of total OA)	132,000 acres (18% of total OA)

Description	Alternative 1 No Action	Alternative 2 Proposed Action	Alternative 3 Public Safety Focus	Alternative 4 Spruce Salvage
treatments)				
Limited to noncommercial, slopes <40%	0	308,000 acres (43% of total OA)	161,000 acres (38% of total OA)	263,000 acres (37% of total OA)
Subsets of the Total Opportunity Area, by species				
Aspen	0	289,000 (40 % of total OA)	190,000 (45 % of total OA)	289,000 (40 % of total OA)
Spruce	0	258,000 (36 % of total OA)	141,000 (33 % of total OA)	258,000 (36 % of total OA)
Aspen-Spruce Mix	0	171,000 (24 % of total OA)	94,000 (22 % of total OA)	171,000 (24 % of total OA)
Geographic limitations that resulted in the opportunity area acreages	N/A	Anywhere spruce, aspen, and spruce/aspen mix vegetation types occur on the GMUG, with the following spatial parameters for treatments: •Outside of public safety areas, commercial treatments[2] would occur only within the identified 24 focus Lynx Analysis Units (LAU). •Non-commercial treatments could occur across the GMUG in spruce, aspen or aspen/spruce mix vegetation types, but would typically[3] exclude suitable lynx habitat.[4]	Spruce, aspen, and spruce/aspen mix treatments would occur under the same parameters as Alternative 2 except they would only occur within the public safety areas as defined in this DEIS. Public safety areas include: - Road corridors - Wildland urban interface (WUI). Defined in this DEIS as a 1 mile buffer from communities, developed sites, and administrative facilities; and within ski area boundaries.	Treatments would occur under the same parameters as Alt. 2, except commercial mechanical treatments would also occur in areas outside the 24 identified focus LAU on suitable timber lands in aspen, spruce or aspen/spruce mix. In comparison to Alternative 2, commercial treatments could occur across an additional 50,000 acres, which includes the non-focus LAU.
Treatments Types Available				
Public Safety Treatments (Y/N)				
Activities for Public Safety: Hazard trees – Spruce and aspen within 300 feet of communication sites; dispersed recreation sites; developed	No	Yes	Yes	Yes

Description	Alternative 1 No Action	Alternative 2 Proposed Action	Alternative 3 Public Safety Focus	Alternative 4 Spruce Salvage
campgrounds and recreation sites; electrical power and above-ground telephone line corridors; and roads open to the public. Incidental species other than spruce and aspen may need to be removed, if pose same hazard. Spruce and aspen treatments within WUI (1 mi buffer): communities, developed sites; administrative facilities; within ski area boundaries				
Subset of Opportunity Areas for Public Safety Treatments in Spruce, Aspen and Aspen-Spruce Mix (acres)				
Within WUI	0	372,000	372,000	372,000
Road corridors outside WUI	0	54,000	54,000	54,000
Mechanical Treatments (Y/N)				
Mechanical Treatments: •Include contract commercial timber harvest (salvage), service contracts, stewardship contracts or agreements and to a lesser extent, Forest Service work crews or cooperators •Near communities and infrastructure, heavy fuels created by treatment would be masticated or piled and burned •Commercial mechanical treatments and non-commercial mechanical treatments involving large equipment on slopes < 40% •Non-commercial mechanical with chainsaws on slopes < or >40% •Cut and chunk, chipping, and hand-cut pile-burn in remote areas •Coppice cutting (in aspen)	No	Yes	Yes	Yes
Aspen Opportunity Areas by Mechanical Treatment (acres) ***Subset of the Total Opportunity Area***				
Commercial and/or noncommercial[5] (lands suitable for timber production)		97,000	76,000	121,000

Description	Alternative 1 No Action	Alternative 2 Proposed Action	Alternative 3 Public Safety Focus	Alternative 4 Spruce Salvage
Limited to noncommercial, slopes >40%		48,000	35,000	48,000
Limited to noncommercial, <40% (not suitable for timber production)		144,000	78,000	121,000
Spruce Opportunity Areas by Mechanical Treatment (acres) ***Subset of the Total Opportunity Area***				
Commercial and/or noncommercial[5] (lands suitable for timber production)		99,000	45,000	115,000
Limited to noncommercial, slopes >40%		56,000	44,000	56,000
Limited to noncommercial, <40% (not suitable for timber production)		103,000	52,000	87,000
Aspen-Spruce Mix Opportunity Areas by Mechanical Treatment (acres) ***Subset of the Total Opportunity Area***				
Commercial and/or noncommercial[5] (lands suitable for timber production)		82,000	42,000	88,000
Limited to noncommercial, slopes >40%		27,000	21,000	27,000
Limited to noncommercial, <40% (not suitable for timber production)		62,000	31,000	56,000
Fire Treatments (Y/N)				
•Prescribed fire for aspen regeneration purposes •Disposal of activity fuels •Pile burning as needed to reduce slash.	No	Yes	Yes	Yes
Spruce Prescriptions Note: More detailed silvicultural prescriptions are in *Appendix A*.				
Activities in spruce	None	Recovery (salvage) prescription for >90% overstory mortality	Same as Alt. 2.	Same as Alt 2, but no resiliency treatments in

Description	Alternative 1 No Action	Alternative 2 Proposed Action	Alternative 3 Public Safety Focus	Alternative 4 Spruce Salvage
		Stands with more live component treated for resiliency: - Resiliency prescription for stands with <40% overstory mortality - Recovery and resiliency prescription for >40% <90% overstory mortality		spruce.
Activities in aspen with spruce-fir understory		Mature aspen stand w/ < 50% SAD: Removal of live aspen to trigger sprouting (coppice). Young healthy aspen stands w/ < 50% SAD: selective removal of spruce-fir to set back successional process in the stand. Prescribed fire as needed to encourage aspen regeneration. Pile burn as needed to reduce fuel loading.	Same as Alt. 2.	Same as Alt. 2
Aspen Prescriptions Note: More detailed silvicultural prescriptions are in *Appendix A*.				
Activities in pure aspen	None	Coppice cutting and prescribed fire to promote regeneration in aspen with <50% overstory mortality, on opportunistic basis in aspen with >50% overstory mortality	Same as Alt. 2.	Same as Alt. 2
Activities in mixed conifer with aspen component[6]	None	Selective removal of spruce-fir and/or other conifer species to allow additional aspen. Broadcast burn in and around mixed stands with aspen to encourage aspen regeneration. Pile burn as needed to reduce fuel loading.	Same as Alt. 2.	Same as Alt. 2
Access These numbers represent maximum potential miles that may be implemented by alternative.[7]				

Description	Alternative 1 No Action	Alternative 2 Proposed Action	Alternative 3 Public Safety Focus	Alternative 4 Spruce Salvage
Road reconstruction, (miles)	0	260	260	260
Designed road construction (miles)	0	60	10	60
Decommissioned designed roads	0	*(48)*	*(8)*	*(48)*
Temporary road construction (miles)	0	260	70	260
Decommissioned temporary roads	0	*(260)*	*(70)*	*(260)*
Road maintenance (miles)	0	444	646	444

[1]Note that due to inaccuracies of vegetation type mapping, minor amounts of treatment could occur outside the actual GIS polygons used in analysis if the vegetation type, stand conditions and management area are such that treatment is warranted by the matrix. Acres rounded to nearest 1,000. Public safety areas, defined as road corridors and the wildland urban interface (WUI) are common to the opportunity area for all action alternatives.
[2]As noted throughout this DEIS, commercial mechanical treatments would only occur on suitable timber lands as defined by the 1991 Forest Plan Amendment (USDA Forest Service, 1991, Appendix F).
[3]Hazard trees within suitable lynx habitat may need to be treated.
[4]In examining GMUG's spatial data, the IDT identified that the majority of spruce-fir that is suitable for timber occur within 24 LAU on the GMUG. These LAU provide cost-effective spatial boundaries for commercial mechanical treatment for planning and analysis purposes.
[5]Noncommercial treatments may also occur on lands suitable for timber production, if conditions warrant; they are not prohibited in such areas.
[6]Plurality of species is Engelmann spruce with aspen. Other conifer species including sub-alpine fir, Douglas-fir, blue spruce, white, fir, lodgepole pine and ponderosa pine may also exist within the stand.
[7] Designed, temporary, and reconstruction miles are a maximum estimate in the event that all roads for each commercial treatment would need to be constructed/reconstructed. At least 80% of designed roads constructed in SBEAMDR would be decommissioned, though the GMUG anticipates decommissioning most, if not all, designed roads constructed for this project. 100% of temporary roads constructed in SBEAMDR would be decommissioned. Some of the identified maintenance would overlap with the miles of potential reconstruction and construction identified. Maintenance would occur on additional, currently existing roads.

Alternatives Considered but Eliminated from Detailed Study

Federal agencies are required by NEPA 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 alternative methods for achieving the purpose and need. Some of these alternatives may have been outside the scope of the project, duplicative of the alternatives or are already components of the alternatives considered in detail, or determined to be components that would cause unnecessary environmental harm. Three alternatives were considered, but dismissed from detailed consideration for reasons summarized below.

Alternative Using Only Existing Roads for Treatment Implementation

This alternative would mirror Alternative 2, except only existing roads would be used for spruce and aspen treatments. This alternative would avoid construction new temporary and designed roads, as analyzed in the proposed action, reducing the area available for treatment relative to the proposed action. This alternative would address the concerns raised in issue 1 and would address comments that stated no new roads should be constructed.

This alternative was eliminated from detailed study because 1) the reduced available treatment area, relative to the proposed action, did not adequately respond to the purpose and need to implement treatments across the GMUG landscape in dead, dying, and at-risk stands, and 2) roads are addressed through design features common to all alternatives, rather than through the development of separate alternatives. The negative effects of roads would be limited by design features regarding the maintenance and decommissioning of roads, guided by the Forest Service Manual and National Best Management Practices. See the rationale for the following alternative for further discussion.

Alternative with No Net Increase in Roads

This alternative would use a combination of existing roads and construction of new designed and temporary roads for spruce and aspen treatments as described in the proposed action. However, in this alternative, all new designed and temporary roads built as a result of implementing the decision for this project would be decommissioned after use; therefore, under this alternative there would be no net increase in permanent roads after project completion. Roads that are authorized to be constructed under this decision could remain open for the approximate 8-12-year implementation timeframe of the project as deemed necessary, avoiding inefficiencies and extra costs of subsequent re-opening of roads needed for later treatments. This alternative would respond to concerns raised in issue 1 that supported the proposed action but stated that no net increase in roads should occur.

This alternative was eliminated from detailed study because the net effect on the amount of roads are addressed through activities and design features common to all action alternatives, rather than the development of a separate alternative. Under each action alternative, priority treatment areas will be identified based in part on ease of access, utilizing existing road infrastructure to the maximum extent feasible. Furthermore, under each action alternative, no new roads would be open to the general public and most (at least 80%) of new designed roads would be decommissioned upon completion of treatment. All temporary roads would be decommissioned.

Alternative with Additional Treatment Areas

This alternative has the same goals and treatments as the proposed action, however, it proposes to increase the effort put toward meeting those goals. This alternative increases the total acres treated in the proposed action and broadens the geographic scope in which those treatments could occur. This alternative was developed to address the concerns of wood products industry and local communities to better reconcile the treatment scale to the landscape scale of the epidemic.

In this alternative, 8,000-12,000 acres would be treated through commercial treatments, and 6,000-12,000 acres would be treated annually through non-commercial treatments, rather than 4,000-6,000 acres and 3,000-6,000 acres of commercial and non-commercial treatments (respectively) as described in the proposed action. The potential treatment area would cover all fifty-one Lynx Analysis Units on the Forest, rather than just the twenty-four LAUs in which the activities of the proposed action would be focused in alternative 2. It would be likely that more miles of roads would be constructed for this alternative.

This alternative was eliminated from detailed study because it is economically unfeasible given current and proposed Forest Service staffing resources. Specifically, the proposed annual treatment targets of this alternative exceed the current and feasible future staffing capacity of the GMUG required to design and administer the individual treatments. The proposed action already contains a maximum estimate of the current and foreseeable Forest Service capacity to design and administer treatments.

It is worth noting that components of this proposed alternative are incorporated into Alternative 4, where a larger geographic area is analyzed for salvage treatments than was proposed in Alternative 2, the proposed action.

Comparison of Alternatives

Table 11 summarizes general effects of alternatives as described in detail in Chapter 3.

Table 11. Comparison of Environmental Consequences of Alternatives.

Resource Areas	Alternative 1 No Action	Alternative 2 Proposed Action	Alternative 3 Public Safety	Alternative 4 Spruce Salvage
General Consequences	No decrease in the threat to human health, safety and firefighters from falling trees and increased fire hazard due to mortality related to spruce beetle and	Immediate threat to human health, safety and firefighters reduced in the public safety opportunity area Recovery treatments allow economic benefits of dead and	Immediate threat to human health, safety and firefighters same as Alt. 2 except is limited to inside the public safety opportunity area Recovery treatments	Immediate threat to human health, safety and firefighters reduced similar to Alt. 2 and available across more acreage than in Alt.3; Recovery treatments

Resource Areas	Alternative 1 No Action	Alternative 2 Proposed Action	Alternative 3 Public Safety	Alternative 4 Spruce Salvage
	SAD; More difficult to safely manage spruce fir fires in the WUI to protect values at risk and outside of the WUI for resource benefit; No additional economic benefit for industry from commercial treatments; Spruce-fir areas with high mortality and limited to no regeneration and/or seed source may not recover spruce-fir component for long-term; Sudden Aspen Decline would continue unchecked; areas with little to no regeneration may not recover aspen component for long-term.	dying trees and increase the cost-effectiveness of all treatments; Increase resilience in treated stands to future insect and disease; Managing fires in treated areas more safe and effective; Potential for future Sudden Aspen Decline reduced in treatment areas.	allow economic benefits of dead and dying trees and increase the cost-effectiveness of all treatments, same as Alt. 2 and limited spatially same as above; Increase resilience in treated stands to future insect and disease less than Alt. 2 and limited spatially same as above; Managing fires in treated areas more safe and effective less than Alt. 2 and limited spatially same above; Potential for Sudden Aspen Decline reduced in treatment areas same as Alt. 2 and limited spatially same as above.	allow economic benefits of dead and dying trees and increase the cost-effectiveness of all treatments, same as Alt. 2 and available across more acreage than Alt.3; Increase near-term resilience in treated stands to future insect and disease less than Alt. 2 and Alt. 3; Managing fires in treated areas more safe and effective similar to Alt. 2 and available across more acreage than Alt. 3; Potential for Sudden Aspen Decline reduced in treatment areas same as Alt. 2 and available across more acreage than Alt.3
Silviculture Consequences	No impacts from project implementation; resources would be subject to natural processes. Spruce-fir areas with high mortality and limited to no regeneration and/or seed source may not recover spruce-fir component for long-term; Sudden Aspen Decline would continue unchecked; areas with little to no regeneration may not recover aspen component for long-term.	Resiliency treatments would effectively reduce the amount of standing live trees by use of single tree and group selection and constribute to increased age-class diversity in treated stands. Recovery treatments would remove trees that have been killed or will die within a very short timeframe, leading to fewer numbers of standing snags across the landscape. There would be a reduction to downed woody debris in the immediate and over the longer term in the treated stands. The reduced amount of downed wood in the treated stands would likely lead to greater establishment	Treatments remain the same under alternative 3 as alternative 2 with the shift to only treating suitable timber lands in the WUI. Treatment focused in the WUI would lead to a greater number of acres of WUI treated. Stands outside the WUI would remain untreated. Age-class diversity in aspen would not be promoted outside of the WUI.	Only spruce stands that have been affected by spruce bark beetle would be treated to meet recovery goals. No green-stand treatments would occur to created multi-stored stand conditions in spruce. The lack of resiliency treatments in spruce stands means that this alternative would not meet the intent of the Western Bark Beetle Strategy. Stands that are not currently affected would receive not treatment; it would effectively leave all the unaffected stands vulnerable to continued and future outbreaks of spruce beetles.

Resource Areas	Alternative 1 No Action	Alternative 2 Proposed Action	Alternative 3 Public Safety	Alternative 4 Spruce Salvage
		of natural regeneration.		
Economic Consequences	No direct effects on the local economy would occur as a result of the No Action. However, economic consequences of inaction may include increased cost of managing wildfires and protecting values at risk from wildfires; cost of damage to infrastructure from fallen hazard trees.	$61.6 million could be gained in labor income annually The project could cost $32.5 million in timber and restoration costs, not accounting for economic value gained through restoring ecosystem services, reduced safety risks and increased ability to manage fires.	$67.9 million could be gained in labor income annually The project could cost $32.0 million in timber and restoration costs, not accounting for economic value gained through restoring ecosystem services, reduced safety risks and increased ability to manage fires.	$74.3 million could be gained in labor income annually The project could cost $27.0 million in timber and restoration costs, not accounting for economic value gained through restoring ecosystem services, reduced safety risks and increased ability to manage fires.
Roads Consequences	No additional roads.	Some roads constructed, most of which would be decommissioned post-project implementation	Fewer roads constructed than alternatives 2 and 4, most of which would be decommissioned post-project implementation	Some roads constructed, most of which would be decommissioned post-project implementation
Wildlife Consequences	There would be no direct effects to wildlife because no treatments would occur. Resources would be subject to natural processes. Spruce-fir stands would remain untreated. Stands currently impacted by the spruce bark beetle would continue to be affected and mortality of trees will continue to occur. This will result in an increase in standing dead trees and an increase in dead trees on the ground which will contribute to fuel loads within this vegetation type. Spruce-fir stands would be at an increased risk of a high intensity fire burning through the stands and because of the amount of dead and dying trees it could potentially result in a stand	Direct effects to wildlife include disturbance and temporary displacement. Indirect effects include habitat degradation and habitat loss as a result of treatment activities. The magnitude of effects to habitat coincides with the treatment to be implemented based on existing stand conditions at the time of implementation. SRLA objectives, standards and guidelines as well as lynx-specific design features will be achieved. Adherence of SRLA will contribute to continued lynx conservation. Other species-specific design features will minimize effects to those species it is intended for. General design features will maintain some habitat	Effects would be similar as Alternative 2 except impacts to habitat would occur within WUI. Overall, less acres would be treated and the benefits to habitat would not be as widespread. Excessive surface and ladder fuels would continue to exist in untreated areas. This would maintain the potential risk of altered fire behavior across the landscape, conditions which would make it difficult for wildland firefighters to manage a wildfire for resource benefit.	Effects would be the same as Alternative 2 except there are no resiliency or restoration treatments included in this alternative. This alternative will result in removal of some stands because of salvage activities. SRLA objectives, standards and guidelines would apply as well as all design features. In the long term, habitat would take longer to reestablish. Benefits would be similar to the proposed action.

Resource Areas	Alternative 1 No Action	Alternative 2 Proposed Action	Alternative 3 Public Safety	Alternative 4 Spruce Salvage
	replacing event. It will also take more time for stands to regenerate and re-establish. Heavy accumulation of dead fall trees on the ground may slow growth of seedlings due to the lack of light and nutrients to seedlings. No treatment to aspen stands would limit aspen regeneration in stands affected by SAD having low natural regeneration.	components for all species across the landscape. In the long term, treatments will benefit all species across the landscape; with the removal of excess ladder and ground fuels, there is slight potential for reducing some impacts of eventual wildfire. With strategic treatments in place, wildland firefighters would also be more likely to manage a wildfire for resource benefit. It will also improve stand conditions in the long term and promote regeneration of stands in the future across the landscape.		
Fuels Consequences	No impacts due to project implementation; resources would be subject to natural processes	Higher amount of surface, ladder and canopy fuels would be reduced due to project implementation as would concomitant reduction in potential fire behavior Additional areas of aspen regeneration would be created leading to fewer areas where fires would slow or go out Greater increase in number of safe locations in which fire fighters can manage fire	Effects same as Alternative 2 except confined and condensed in the WUI	Effects generally the same as Alternative 2 except slightly more beetle-infested trees would be removed, which could lead to mildly lower potential for ember lofting and crown fire behavior.
Water and Soils Consequences	No impacts due to project implementation; resources would be subject to natural processes	Most effects will be insignificant to moderate, localized and short to moderate term.	Reduced effects compared to Alternative 2, most effects will be insignificant to moderate, localized and short to moderate term.	Increased effects compared to Alternative 2, most effects will be insignificant to moderate, localized and short to moderate term.
Botany, Invasive plants, Air, Heritage, Range, Recreation, and Visual Resources	No impacts due to project implementation; resources would be	Effects would be limited by use of design features, project	Effects would be limited by use of design features, project	Effects would be limited by use of design features, project

Resource Areas	Alternative 1 No Action	Alternative 2 Proposed Action	Alternative 3 Public Safety	Alternative 4 Spruce Salvage
	subject to natural processes	implementation checklist and implementation monitoring.	implementation checklist and implementation monitoring.	implementation checklist and implementation monitoring.

CHAPTER 3. AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

Introduction

This chapter describes the affected environment for each resource analyzed. Subsequently, the environmental consequences of the alternatives on the resource components of the physical, biological, and social environment in the SBEADMR Project Area are disclosed. Environmental consequences are described in terms of the beneficial/adverse, short and long-term direct/indirect and cumulative effects. Effects are quantified where possible, although qualitative discussion is often necessary. Elements that are not affected or minimally affected by the alternatives such as noise and topography are not discussed. This chapter provides the scientific and analytical basis for the comparison of alternatives presented in Chapter 2.

Direct and indirect effects of the proposed action and its alternatives were analyzed over the planning period (8-12 years). Cumulative effects take into account past, present, and reasonably foreseeable activities from actions other than the SBEADMR Project, in addition to direct and indirect effects of the SBEADMR Project. The area analyzed for cumulative effects is the project area for all resources unless otherwise noted. Cumulative effects are disclosed under each resource topic. *It is important to note that the amount (e.g. acres, miles, etc.) of a certain activity in any alternative is approximate (based on inventory and survey estimates).*

In order to understand the contribution of past actions to the cumulative effects of the proposed action and alternatives, this anlaysis considers past and present activities in the affected environment to establish a baseline for analyzing direct, indirect and cumulative effects.

This cumulative effects analysis does not attempt to quantify the effects of past human actions by adding up all prior actions on an action-by-action basis. The Council of Environmental Quality issued an interpretive memorandum on June 24, 2005, regarding analysis of past actions. The memorandum states, “agencies can conduct an adequate cumulative effects analysis by focusing on the current aggregate effects of past actions without delving into the historical details of individual past actions.”

The cumulative effects analysis in this EIS is also consistent with Forest Service National Environmental Policy Act (NEPA) Regulations (36 CFR 220.4 (f)) (July 24, 2008), which state, in part:

> CEQ regulations do not require the consideration of the individual effects of all past actions to determine the present effects of past actions. Once the agency has identified those present effects of past actions that warrant consideration, the agency assesses the extent that the

effects of the proposal for agency action or its alternatives would add to, modify, or mitigate those effects. The final analysis documents an agency assessment of the cumulative effects of the actions considered (including past, present, and reasonably foreseeable future actions) on the affected environment. With respect to past actions, during the scoping process and subsequent preparation of the analysis, the agency must determine what information regarding past actions is useful and relevant to the required analysis of cumulative effects. Cataloging past actions and specific information about the direct and indirect effects of their design and implementation could in some contexts be useful to predict the cumulative effects of the proposal. The CEQ regulations, however, do not require agencies to catalogue or exhaustively list and analyze all individual past actions. Simply because information about past actions may be available or obtained with reasonable effort does not mean that it is relevant and necessary to inform decision making (40 CFR 1508.7).

The resource components described in this chapter are arranged in three sections:

- Physical Environment
- Biological Environment
- Social Environment

Design features (Appendix B) are incorporated into all action alternatives and associated effects analyses. The design features were developed from laws, regulations, Forest Service Manual or Handbook policy, standard contract language, Forest Service-approved best management practices, or Forest Plan guidelines. These items are considered to be standard management practice as provided by the aforementioned sources, as they have been proven effective during implementation of similar vegetation treatments as proposed in this DEIS. These features derive from decades-long practices and/or more recent best available science. These design features translate legal provisions and scientific principles into solid, commonsense stewardship actions that support continued sustainable resource use (USDA Forest Service 2006c)

Design features are subject to change resulting from 1) change in policy or management direction (e.g. amendments or revision of the Forest Plan, federal listing of a species, etc.) and 2) when new science indicates design feature should be modified or replaced to improve effectiveness. Potential changes would be evaluated during annual Management Reviews.

Physical Environment

This section will describe the affected environment and environmental consequences for each resource of the physical environment (Soil and Water and Transportation).

Watershed and Soil Resources

This section discusses the components of the GMUG watershed and soils resources that may be affected by the proposed activities. Components include watershed condition class, water quality, water yield, stream flow regimes, fens, wetlands, groundwater, soil erosion and compaction potential, soil productivity, and effects to aquatic and riparian habitats.

The information in this document is based on published sources, GMUG planning documents, and GMUG GIS data. GMUG watershed and soils resources staff was consulted; Forest direction documents including the 1991 Forest Plan and regional and national Forest Service Handbooks were reviewed; as were pertinent reference literature regarding the effects of proposed treatments. Descriptions and basic analyses using the GMUG GIS library were conducted to determine existing conditions and relative risk to watersheds and soils. Field surveys to identify soil and water resource areas of concern and appropriate design features and BMPs to be implemented will be conducted prior to implementation for each treatment.

Compliance with Regulatory Direction

Federal regulatory direction guiding this project include Federal Executive Order 11988 – Floodplain Management (Environmental Protection Agency, 2012b), Federal Executive Order 11990, "Protection of Wetlands," (Environmental Protection Agency 2012c) and the Clean Water Act of 1977 (Environmental Protection Agency 2012a). State regulatory direction that applies to watershed protection in this project is the *5 Code of Colorado Regulations* issued by the Colorado Department of Public Health and Environment, Water Quality Control Commission under their authority from Environmental Protection Agency (EPA) through the CWA (Colorado Water Quality Control Commission 2012).

Forest Service Direction includes the Forest Manual sections 2532.02 and 2532.03 for watershed and Forest Service manual 2550 for soil, the National Best Management Practices (BMP) Program, the Watershed Conservation Practices Handbook (FSH 2509.25) and the GMUG Forest Plan. The relevant Forest Plan goals that are applicable to water resources and soils for this project are listed below.

Riparian and Stream Area Management

- Design and implement activities in management areas to protect and manage the riparian ecosystem.
- Manage riparian areas to reach the latest seral stage possible within the stated objectives.
- Prescribe silvicultural and livestock grazing systems to achieve riparian area objectives.

- Locate, and construct all roads to maintain the basic natural condition and character of riparian areas.
- Prevent or remove debris accumulations that reduce stream channel stability and capacity.
- Prevent stream channel instability, loss of channel cross-sectional areas, and loss of water quality resulting from activities that alter vegetative cover.
- Maintain sediment yield within threshold limits. The effects on water and sediment yields from vegetation manipulation and road construction projects will be determined through the use of appropriate modeling and/or quantification procedures to determine sediment yield threshold limits and water yield change potentials.
- Treat disturbed areas resulting from management activities, to reduce sediment yields to the natural erosion rates in the shortest possible time.
- Prevent soil surface compaction and disturbance in riparian ecosystems. Allow use of heavy construction equipment for construction, residue removal, etc. during periods when the soil is least susceptible to compaction or rutting.
- Maintain or enhance the long-term productivity of soils within the riparian ecosystem.

Soil and Water Resource Management

- Maintain instream flows and protect public property and resources.
- Improve or maintain water quality to meet State water quality standards. However, where the natural background water pollutants cause degradation, it is not necessary to implement improvement actions. Short-term or temporary failure to meet some parameters of the State standard, such as increased sediment from road crossing construction or water resource development may be permitted in special cases.
- Rehabilitate disturbed areas that are contributing sediment directly to perennial streams as a result of management activities to maintain water quality and re-establish vegetation cover.
- Prevent or reduce debris accumulations in riparian areas that reduce stream channel stability and capacity.
- Prevent soil surface compaction and disturbance in riparian ecosystems. Allow use of heavy construction equipment for construction, residue removal, etc. during periods when the soil is least susceptible to compaction or rutting. Limit use of herbicides, insecticides, rodenticides, or other chemical agents as part of management activities to times and places where possible transport to or by surface water has a low probability of occurrence. Follow all label requirements concerning water quality protection. Maintain soil productivity, minimize man-caused soil erosion, and maintain the integrity of associated ecosystems.

- Obliterate and rehabilitate those existing travel ways identified for return to resource production.
- Identify at the treatment level, upland areas that are immediately adjacent to Riparian (Prescription 9A) Management Areas. Adjacent upland areas are those portions of a management area which, when subjected to management activities, have a potential for directly affecting the condition of the adjacent Riparian Management Area. The magnitude of effects is dependent upon slope steepness, and the kind, amount, and location of surface and vegetation disturbance within the adjacent upland unit.

Compliance with regulatory requirements will be met by the use of design features and best management practices (BMPs) as described in Appendix B. Project-level surveys will be conducted and results used to guide layout of management activities. Field reconnaissance and planned management activities will determine the appropriate design features and BMPs to implement. Annually, three projects will be randomly selected, one from each of the three timber zones on the forest, and evaluated to ensure that the appropriate design features and BMPs were selected for the project, implemented and functioned as designed.

Affected Environment

Information on soil and water resources in the affected watersheds, including watershed condition class, water quality, water yield, stream flow regimes, fens, wetlands, groundwater, and soils characteristics is provided in the following documents:

- 1991 Final supplemental Environmental Impact Statement: Grand Mesa, Uncompahgre, and Gunnison National Forests (Amended FEIS)
- 1991 Amended Land and Resource Management Plan: Grand Mesa, Uncompahgre, and Gunnison National Forests (Amended LRMP)
- 2006 Proposed Land Management Plan Comprehensive Evaluation Report: Grand Mesa, Uncompahgre, and Gunnison National Forests (2006 LRMP Report)
- 2001 Ecological Types of the Upper Gunnison Basin (2001 Eco Types Report)
- 2012 Inventory of Fens in a Large Landscape of West-Central Colorado (2012 Fen Inventory)
- 2005 Aquatic, Riparian, and Wetland Ecosystem Assessment (Assessment Report)
- 2012 Colorado Water Quality Control Commission 303(d) list

This and new information are incorporated by reference and summarized for this analysis.

Watershed

Watershed Condition Class

The GMUG reclassified watershed condition class as part of a 2011 national effort. The process is outlined in the *Watershed Condition Framework and Technical Guide* (USDA Forest Service 2011g and 2011h). Watershed condition is based on a 12-indicator model that considers both aquatic and terrestrial physical and biological indicators. Specific indicators include; water quality, water quantity, aquatic habitat, aquatic biota, riparian/wetland vegetation, roads and trails, soils, fire regime, forest cover, rangeland vegetation, terrestrial invasive species and forest health. Indicators are individually rated, then summed based on a weighting factor to give a rating of Class 1 (functioning properly), Class 2 (functioning at risk) or Class 3 (impaired function). A watershed rated between a score of 1.0 and 1.6 is a Class 1 watershed. A watershed rated between a score of 1.7 and 2.2 is a Class 2 watershed. A watershed rated between a 2.3 and 3.0; is a Class 3 watershed (USDA Forest Service 2011g).

A watershed is considered to be functioning properly (Class 1) if the physical attributes are appropriate to maintain or improve biological integrity, i.e. the watershed is functioning in a manner similar to natural wildland conditions (USDA Forest Service 2011g). Class 2 and Class 3 watersheds have impaired function because some physical, hydrological, or biological thresholds have been exceeded. This can occur due to natural processes, such as wildland fire or large slope failures, but are more typically caused by human related disturbance, such as roads close to streams, overgrazing by domesticated animals, invasive species, or presence of aquatic non-native species.

The GMUG includes 231 watersheds. Of these, 156 are Class 1; 75 are Class 2 and no watersheds are Class 3 (USDA Forest Service 2011h). There are 51 borderline Class 1/Class 2 watersheds encompassing the GMUG. These watersheds have a Watershed Condition Class score of 1.6 and are at a higher risk of moving from Class 1 (Functioning Properly) to Class 2 (Functioning at Risk) due to natural (wildland fire) or human (roads or timber harvest) causes. Table 12 lists the borderline Class 1/Class 2 HUC12 watersheds. **Error! Reference source not found.** shows the watersheds in the GMUG and their condition classes. Descriptions of the borderline Class 1/Class 2 watersheds, including acreages on National Forest System lands, miles of streams, number of road-stream crossings, Watershed Condition Class score, and whether they are listed municipal supply watersheds are available in the specialist's Watershed Report in the project record.

The relative risks of additional impacts from treatments are evaluated based on the following characteristics:

- Percent of the watershed with opportunity areas

- Percent of the watershed affected by past and on-going disturbances, such as grazing, timber harvest, and wildland fires, etc. Activities going back at least 25 years were summarized and are largely reflect in the watershed condition class score.
- Existing road density and estimated proposed road acres
- Number of existing stream crossings
- Percent of watershed within and outside Forest System Land
- Percentage of the watershed with wetlands and fens.

Municipal Supply Watersheds

The Forest Service recognizes state delineated "Source Water Areas" as "Municipal Supply Watersheds" per the definition in FSM 2542 (SWAP MOU with CDPHE, 2014). These areas are managed for multiple use outputs while providing protection of water quality to meet municipal water supply needs. Nearly all of the GMUG watersheds are Municiple Supply Watersheds. In fact, only 19 of the 231 HUC12 watersheds in the GMUG do not include source water areas. For the purposes of site-specific analyses, every HUC12 watershed will be evaluated as if it were a Municipal Supply Watershed. Municipal Supply Watersheds are noted on the watershed description tables available in the Watershed Report in the project record.

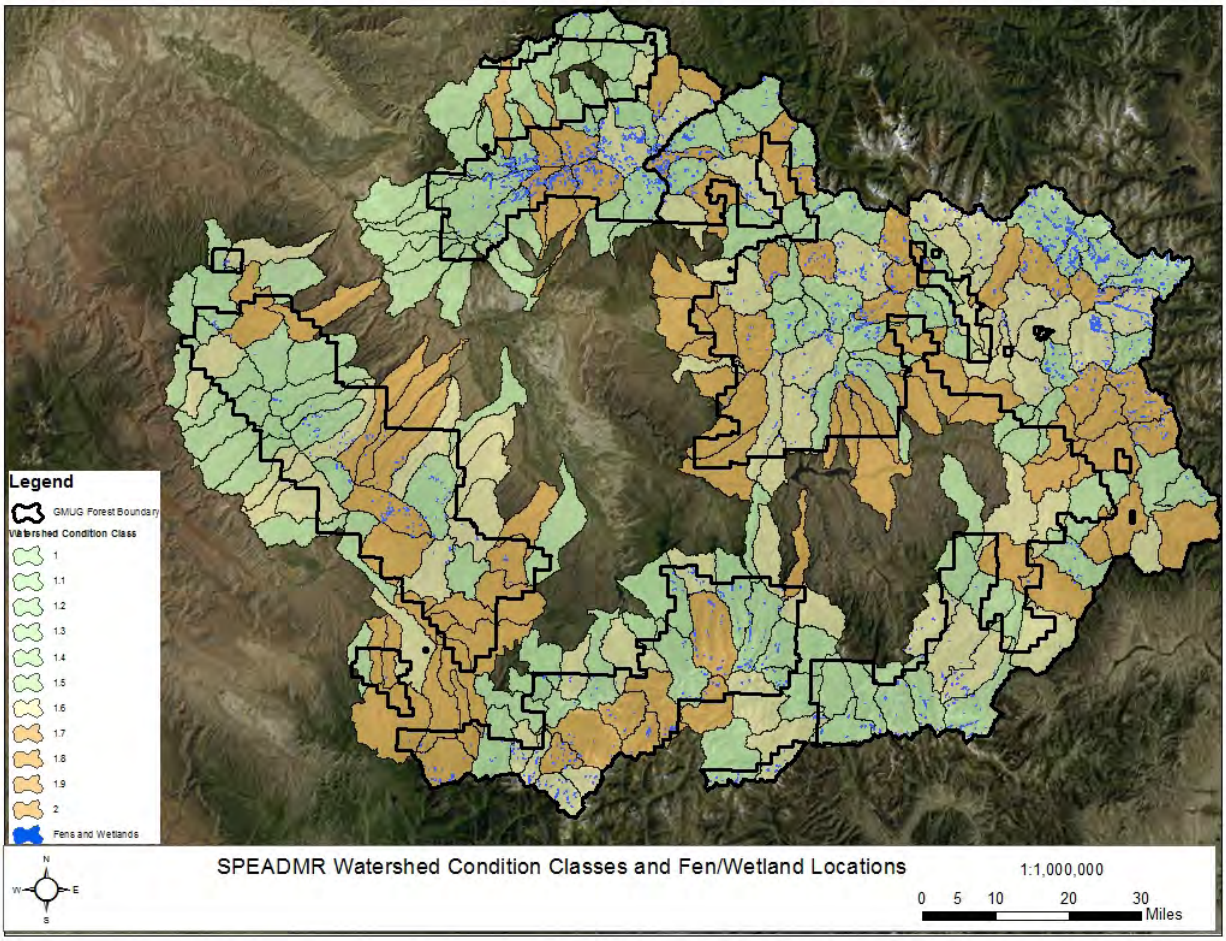


Figure 15. SBEADMR watershed condition classes and fen/wetland locations

Table 12. GMUG Borderline Class 1/Class 2 Watersheds

HUC 12 Code	HUC 12 Watershed Name
140100051102	Headwaters Buzzard Creek
140100051105	Harrison Creek-Buzzard Creek
140100051201	Leon Creek
140200010106	Outlet Willow Creek
140200010108	Lottis Creek
140200010111	Bear Creek-Spring Creek
140200010112	Beaver Creek
140200010113	Lower Taylor River
140200010201	Upper East River
140200010202	Brush Creek
140200010203	Middle East River

HUC 12 Code	HUC 12 Watershed Name
140200010209	Roaring Judy Creek
140200010210	Lower East River
140200020506	Rock Creek
140200020602	Lake Sanc Cristobal-Lake Fork
140200020604	Nellie Creek-Henson Creek
140200020607	Trout Creek-Lake Fork
140200020704	West Soap Creek-Soap Creek
140200020705	Cow Creek-Soap Creek
140200020802	Little Blue Creek
140200020902	Upper Cimarron River
140200021002	Curecanti Creek
140200021003	Corral Creek-Gunnison River
140200021204	Crawford Reservoir
140200030104	Long Branch Creek
140200030202	Outlet Razor Creek
140200030502	Pauline Creek
140200030503	Archuleta Creek
140200030504	Headwaters Los Pinos Creek
140200030509	Outlet Cochetopa Creek
140200040103	Outlet West Muddy Creek
140200040301	Ruby Anthracite Creek
140200040406	Terror Creek
140200040407	Miller Creek
140200050203	Middle Roubideau Creek
140200050304	East Fork Escalante Creek
140200050603	North East Creek
140200060205	Coal Creek-Uncompahgre River
140200060206	West Fork Dallas Creek
140200060501	Headwaters Dry Creek
140200060502	Upper Dry Creek
140200060504	Middle Dry Creek
140300030101	Howard Fork
140300030102	Lake Fork
140300030104	Bilk Creek
140300030107	Bear Creek
140300030203	Lower Horsefly Creek
140300030405	Headwaters Maverick Draw
140300030603	Shavano Creek-Tabeguache Creek
140300030604	Spring Creek
140300030605	Campbell Creek
140300040402	Calamity Creek

Hydrologic Function

Hydrologic function is the ability of a watershed to infiltrate precipitation and naturally regulate runoff so streams are in dynamic equilibrium with their channels and floodplains. Management measures and design criteria to protect hydrologic function apply to all actions that may impact the "sponge and filter" qualities of watersheds. Hydrologic function is protected by maintaining good vegetation and ground cover and by minimizing connected disturbed areas (USDA Forest Service 2006).

Healthy streams maintain good hydrologic function and provide resilience to watershed conditions. Stream health depends largely on channel widths and depths, bank stability, and quality of cover and substrate. Management activities, including vegetation treatments, timber harvest, and road construction can negatively affect stream health by removing cover, increasing soil erosion and sediment transport to streams, and compacting soils. Implementation of design features and Best Management Practices (BMPs) reduce the potential for negative effects. Specific design features and BMPs are discussed later in this document.

Surface Water

Surface water conditions vary tremendously across the GMUG, depending on geology, topography, microclimate, soil type, and other factors. The 1991 LRMP (USDA Forest Service 1991a) notes that there are an estimated 3,657 miles of perennial streams, 1,390 miles of major (named) intermittent streams, and 5,815 miles of minor (unnamed) intermittent streams within the Forests' boundaries.

Beneficial Uses and Impaired Waters

Although surface water quality is generally excellent within the Forests' boundaries, the State of Colorado identified segments in 21 streams totaling approximately 141 miles that do not meet water quality standards, generally due to metals concentrations related most often to historic mining activities (Colorado Water Quality Control Commission 2012). Impaired streams and their beneficial uses identified within the GMUG are listed in the project file.

Proposed treatment activities are unlikely to affect the specific impairments in the identified waterbodies, which are mostly related to historic mining activities. Design features and BMPs will be used to minimize the potential to adversely impact other water quality parameters, such as sediment, turbidity, and temperature.

Stream Connectivity

Dams associated with manmade impoundments affect stream connectivity and aquatic organism passage. Small dams on non-NFS land and instream structures, such as "perched" culverts at

road-stream crossings and irrigation diversions, also exist, fragmenting the stream network and blocking fish passage.

Unpaved road surfaces are a long-term source of sediment input into waterbodies. The proximity of a road to a waterbody increases the potential for sediment input. Roads within water influence zones (WIZs) and road-stream crossings are typically higher contributors of sediment input to waterbodies. There are approximately 4,683 road crossings on perennial and intermittent streams across the GMUG. This number includes only road-stream crossing on Forest System Lands and roads both open and closed to motorized use.

Water Yield

The water provided by streams that flow from the GMUG is an important resource utilized for drinking water supplies, irrigation, stock watering, fisheries, and recreation in the surrounding area. Most of the HUC12 watersheds encompassing the GMUG are Municipal Supply Watersheds. The GMUG produces approximately 2.8 million acre-feet of runoff that feeds approximately 3,600 miles of streams and supports about 11,650 surface acres of lakes and reservoirs (2006 LRMP Report). Annual water yield depends upon the density or coverage of the forest, the type of forest vegetation, whether most of the forest is living or dead, as well as many other factors including climate, weather patterns, geology, slope, soils, stream channel conditions and riparian area conditions.

Forested land helps conserve moisture by providing shade and cooler temperatures which provide for less overall evaporation. Floodplains, wetlands and fens store substantial volumes of surface and shallow groundwater, which supports dense vegetative cover. The transpiration of moisture back to the atmosphere contributes to rain and snow development in the area

At higher elevations, snow is the predominant form of precipitation. In the Rocky Mountains, as much as 75 percent of annual precipitation is in the form of snow (Elder 2006). The tree canopy, whether living or dead, intercepts a significant volume of snowfall. Snow sublimates (changes directly from a solid to a vapor) in subfreezing temperature. The increased surface area of snow in the tree canopy results in an estimated loss of 20 to 35 percent of the total snowfall to sublimated interception (Lisle, et. al 2010, Elliot 2010).

Large-scale removal of live trees can alter water yield by reducing interception and evapotranspiration. Removal of dead trees also reduces interception but does not change evapotranspiration. Canopy removal allows snow to reach the ground, increasing snowpack depth. Less snow is lost to sublimation so more is available during spring snowmelt for runoff (Elder, 2006). This increases runoff into streams, groundwater recharge and peak flows (Troendle 1987, Baker, 1986, Bosch 1982, Cahill 1951, Troendle 2000). Troendle and King reviewed studies of the effects of timber harvest on water yield and determined that, after

clearcutting, approximately one-third of the increased water yield was due to savings from canopy sublimation and two-thirds to decreased evapotranspiration. The increase in water yield is only seen if a minimum of 20 percent of the watershed is clearcut (Elliot 2010).

Harvest of 20 or more percent of a watershed is uncommon, but could occur cumulatively over several years within the GMUG. Increases in water yields decline as new vegetation grows to replace the harvested trees. However, it takes decades, possibly 60 years or more, for water yields to return to background in the Rocky Mountains (Elliot 2010).

The effects of the death of large numbers of multi-age spruce and fir trees is similar to large-scale timber harvesting and can also increase water yield to a lesser degree (Cahill 1951) but there are too many unknown factors to make predictions (Elder 2006). Beetle-killed trees retain their needles for a year or two after infestation, intercepting and retaining snow in much the same way as live trees. As needles drop, less snow is intercepted and as trees fall, open areas increase with resulting increases in snowpack thickness. It may take one to 15 years for the increase in water yield from uncut beetle-killed trees to match water yield in clearcut areas (Hubbard 2014). In areas where aspen replace spruce, and in spruce/aspen stands where the spruce over-story dies, some change in water yield could be expected.

Aspen also modifies hydrological dynamics in ways that benefit biota and streamflow. Results of modeling based on rates of water movement by season in various tree species suggested significantly greater water yield from aspen than from conifer forests (Humphries 1984).

The Forest Service recognizes state delineated “Source Water Areas” as “Municipal Supply Watersheds” per the definition in FSM 2542 (SWAP MOU with CDPHE, 2014). These areas are managed for multiple use outputs while providing protection of water quality to meet municipal water supply needs. Nearly all of the GMUG watersheds are Municipal Supply Watersheds. In fact, only 19 of the 231 HUC12 watersheds in the GMUG do not include source water areas. For the purposes of site-specific analyses, every HUC12 watershed will be evaluated as if it were a Municipal Supply Watershed.

Floodplains, Wetlands, Fens, and Riparian Areas

Floodplains are natural inundation areas for floods that reduce flood stages and velocities. Most streams have a floodplain, although it may be intermittent and narrow. Floodplains store water, serve as natural sponges to moderate the release of high waters and act as filters to trap sediment and pollutants. They are important because the loss of floodplain function can change the timing and peak of stream flows allow more sediment deposition in stream channels, and reduce riparian habitat.

Riparian areas and floodplains were mapped based on aerial photo interpretation and field surveys. There are 128,019 acres of mapped riparian areas, including floodplains, within the GMUG. Treatment-level field surveys will be conducted prior to implementation to delineate floodplains.

Wetlands control runoff and water quality, recharge ground water and provide special habitats. Actions that may alter ground cover, soil structure, water budgets, drainage patterns and long-term plant composition can impair these characteristics.

Fens are a subset of wetlands which are groundwater dependent and accumulate peat (USDA Forest Service 2010). Fens are rare features and host a number of rare plant species. The hydrologic conditions supporting fens and wetlands can be readily impacted by roads and other ground disturbing activities.

Another subset of wetlands are wet meadows that are topographic depressions which are periodically saturated and show evidence of standing water as a result of snow melt and/or rain events. These land features act as ephemeral drainages and provide areas of groundwater recharge that support groundwater dependent ecosystems such as fens and springs.

The National Wetland Inventory completed by the U. S. Fish and Wildlife Service mapped wetlands but digital data is only available for portions of the Grand Mesa and Gunnison areas of the GMUG (US Fish and Wildlife Service 2014). Many of the wetland areas mapped by the Fish and Wildlife Service are also included in the GMUG riparian GIS layer. Since 2008, GMUG staff conducted an inventory of the number and location of fens and associated wetlands and evaluations of the condition of fens and associated wetlands (Johnston 2012). Fens were initially identified through aerial photo interpretation followed by statistically valid field surveys based on local conditions including geology, elevation, aspect, climate, and soil types.

The number and acreages for wetlands and fens are approximate and are derived from the GMUG GIS library. Floodplains are not documented separately from riparian areas. Treatment-specific field surveys will be conducted to determine actual conditions and potential treatment impacts. The type, number and acres of wetlands and fens present in the opportunity areas are shown in Table 14.

Table 13. Wetlands, Fens and Riparian Areas within the GMUG.

Wetland Type	Number Present	Total Acres[1]	Acres within Opportunity Areas
Fen and Associated Wetland	3,376	8,071	3,073
Riparian Area	N/A	111,177	20,671
Sources: GMUG GIS library Some acres may be counted as both wetlands and riparian areas.			

Springs are defined as *"place where ground water flows naturally from a rock or the soil onto the land surface or into a body of surface water."* (Wilson 1998). Springs are managed as a subset of wetlands due their unique characteristics. Also, springs are a primary factor for determination of a groundwater dependent ecosystem (a subset of wetlands). The Watershed Conservation Practices Handbook states "avoid any loss of rare wetland such as fens and springs," (USDA Forest Service 2006b). There are at least 8,071 known fens within the GMUG and nearly all are within opportunity areas. There are at least 508 springs within the GMUG and approximately 235 are within opportunity areas.

Water Influence Zones (WIZ) are those lands that interface between water and drier uplands. WIZs are some of the most ecologically diverse habitat types and provide bank stability, sediment filtering, streamside shading and nutrient input into streams and lakes. The GMUG 1991 LRMP lists the minimum horizontal width of the WIZ for various water related features as described in Table 13. WIZs include floodplains and riparian areas. Use of mechanical equipment and proposed treatments are restricted in WIZs to protect habitat and allow WIZs to perform their natural functions.

Table 14. Minimum Horizontal Width of Water Influence Zones (WIZ)

Feature	Outside Edge of WIZ	No Harvest or Mechanical Travel Zone
Fens and their associated wetlands	100 ft. minimum from edge of fen	100 ft. from edge of fen
Perennial Streams	100 ft. from stream bank	50 ft. from stream bank
Intermittent Streams, Reservoirs and Ponds	50 ft. from bank or high water line	25 ft. from bank or high water line
Wetlands ≥ ¼ acre	100 ft. from edge of wetland	50 ft. from edge of wetland
Springs/Seeps/Wetlands/ depressional recharge areas < ¼ acre	50 ft. from the source or edge of associated wetland, whichever is greater	25 ft. from the source of edge of associated wetland, whichever is greater
Ephemeral Streams and Swales	25 ft. from the channel or topographic low	
Ditch	Edge of Right of Way	

WIZs also include floodplains, depressional recharge areas, and riparian areas in general.

For the purpose of implementing protection measures, the term swale and ephemeral stream are considered to be synonymous. The measures are intended to avoid or minimize surface disturbance, not the nature of silvicultural treatments.

Climate Change

Predictions of how the Rocky Mountains' climate is changing are based on records of past measurements and various modelling predictions. Results of climate modelling are uncertain and sometimes conflict with each other. However, recent temperature and precipitation measurements suggest overall trends in these climate parameters.

Climate modeling in the Rocky Mountain region indicates that temperatures will likely increase by several degrees over the upcoming decades. Precipitation amounts will show more variable changes with the possibility of more precipitation in the northern part of the area and less in the south. Where there is more precipitation, more will arrive as rain during the cooler months and fewer summer storms will occur (Rocca 2014).

Changes in temperature and precipitation timing and amount have the potential to affect watershed and soils resources in many ways. The availability and timing of water yield will require changes in water storage operations (Day 2013). Warmer and drier summers could increase the potential for severe wildland fires resulting in greater erosion potential which reduces soil productivity and increases sediment loading to streams and waterbodies. Riparian and wetland features could receive less water, reducing their size and capability of sustaining water dependent plant and animal species.

Soils

The analysis area lies within the GMUG Soil Survey Areas originally published by the Natural Resource Conservation Service and available online at http://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx. Soils data for the GMUG was compiled into the GMUG GIS library. Soils data for this report was extracted from the GMUG GIS library.

All soils were mapped at a scale of 1:24,000, and are considered to be a 3rd order level of survey. Order 3 is a mapping intensity intended for areas with a single dominant use, where precise knowledge of small areas is not required. Because it is a 3rd order survey and given the inherent variability of soils, treatment proposals generally need to be reviewed to confirm slope, depth, drainage, and other soil and site characteristics that may affect a particular use.

The extremely varied geology, topography, climate, and vegetation in the treatment area results in a large number of soil types across the GMUG. Specifics of soil types and characteristics are too numerous to list, but pertinent characteristics and potential effects are discussed in this

document. Surveys and analyses of soils characteristics will be conducted on all proposed units prior to treatments in accordance with the Pre-treatment Implementation Checklist.

Erosion Hazard Rating

The erosion hazard rating (EHR) is a rating of how erodible a soil is and is based on soil type, surface cover, slope gradients, slope lengths, and the historical climate for the. Soils with severe or very severe EHRs are most prone to erosion when surface cover is removed and the soil surface is disturbed, such as by timber harvest activities or roads.

Productivity

Soil productivity is the ability of the soil to supply the water and nutrients needed to sustain plant growth. Variables that influence soil productivity include soil physical characteristics, organic matter and soil biological activity. Disturbance from timber harvest activities and roads reduces soils productivity due to compaction and removal of organic material. Leaving slash from timber harvest and fuels management activities adds surface cover and nutrients to the soils. High severity fire can reduce soil productivity by changing soil structure and chemistry, and destroying soil microorganisms.

Organic Matter

Organic matter in its various forms contributes to soil productivity by providing nutrients and moisture retention for soil organisms and plants. Humus is decomposed organic matter. Duff and litter are partially decomposed leaves, needles and twigs on the surface of soils. Large woody debris consists of woody stems greater than three inches in diameter. Decomposed large woody debris can supply moisture to plants after soils dry.

Studies have shown that the amounts of nitrate, total nitrogen, and ammonium increase in the soil in areas where beetle-killed trees were harvested over areas where these trees were not harvested (Rhoades 2012). In addition, loss of trees due to beetle kill and harvest increases the available soil moisture (Hubbard 2014). Harvesting dead trees could increase the amount of available nutrients and soil moisture available for growth of new vegetation.

Biological Activity

Soil organisms, including fungi and bacteria, are required by and drive the nutrient cycling process by decomposing organic matter components and releasing the nutrients for use by plants. Soil organisms depend on organic matter for the nutrients they need to carry out their life processes. Decomposed large woody debris provides important habitat for the survival of mycorrhizae fungi. These fungi form a symbiotic relationship with tree roots, increasing water and nutrient uptake by the trees and the fungi.

Physical Characteristics

Soil physical characteristics include soil depth, soil pore space and bulk density. Changes in these occur when ground-based mechanical equipment makes repeated passes over the soil. These activities compress or compact soils and, if soils are wet enough, can result in rutting. Finer-grained soils, such as clay and loam soils generally compact more than sandy soils (USDA Forest Service 2006b). These changes to the physical soil characteristics reduce the pore space volume and water holding capacity which result in reduced infiltration rates, slow soil drainage, interference to root growth, and reduced plant-available water and nutrients. Physical soil disturbances also decrease gas exchange, affecting both plants and soil biota.

Soil Porosity and Compaction

Soil porosity is the volume of pores in a soil that can be occupied by air, gas, or water and varies depending on the size and distribution of the particles and their arrangement with respect to each other. The use of heavy forestry equipment and frequent stand entries increases bulk density and decreases the porosity of soils, which increases the potential for detrimental compaction (Powers et al. 1998). To prevent excessive overland flow and erosion, soil structure and macro-porosity in the top 8 inches of mineral soil for most of the stand area should be similar to the undisturbed, natural condition for the soil type and should provide sufficient infiltration and permeability for the given climate. The degree and extent of susceptibility to compaction is primarily influenced by soil texture, soil moisture, coarse fragments, depth of surface organic matter, ground pressure weight of the equipment, and whether the load is applied in a static or dynamic fashion. Forest Service direction limits soil compaction, severely burned soil, and disturbance to no more than 15 percent of the treatment area (USDA Forest Service 2006a). Soil compaction and increased soil strength can slow plant growth, impeded root development, decrease water infiltration, restricted percolation, increased overland flow during high precipitation events, and can cause plant nutrients to be relatively immobile or inaccessible (Poff 1996). Recent research suggests that the effect of severe compaction on biomass productivity is highly dependent upon soil texture (Powers et al. 2005).

Erosion

Soil erosion is the movement of soil particles by water, wind or ice. In forested sites on steep slopes, water is the generally the most common driver of erosion. Erosion removes fertile topsoil, reducing soil productivity; creates gullies which can damage roads and trails; and can deposit sediment in waterbodies, wetlands, and fens, damaging habitat for vegetation and aquatic organisms. On the GMUG in general, the potential for the greatest erosion is on steeper slopes and potential decreases as the slope decreases (USDA National Resource Conservation Service undated). Soil erosion can occur when the surface soil is compacted or when the loose surface soil and its protective layer of organic material are changed or removed, such as by disturbances associated with management activities. Compaction and rutting can affect infiltration to the point

that there can be a reduction in the movement of water into the soil and water can be channeled and concentrated on the surface. As a result, water runoff (overland surface flow) is increased and carries soil particles with it.

Natural disturbance occurrences such as fire result in the removal of organic matter layers from the soil surface. When surface organic matter is removed, soil pores can become plugged by material (particles) and impacted from precipitation, resulting in overland surface flow and increased rates of soil erosion.

Mass Failure

Mass failures (also known as mass movement, soil slippage or landslides) can be triggered by natural or man-made disturbances. Mass failures can be triggered by changed conditions resulting from sequences of natural events, such as wildfire followed by high intensity precipitation events. Some areas on the GMUG have characteristics that contribute to a greater potential for instability and are considered to have a greater likelihood or susceptibility to mass failures based on those characteristics which typically include soil or bedrock features. This includes the area in the northeastern portion of Grand Mesa where the recent massive rock avalanche near Collbran occurred.

Management activities can contribute to changing soil moisture conditions such as contributing to saturated conditions in localized areas. Activities can create conditions that result in channeling water and concentrating it onto a limited area on hill slopes, such as below a road culvert or a rutted skid trail. Mass failures triggered by human causes are classified as detrimental soil disturbance. These disturbances result in significant long-term changes in soil productivity that last centuries

Soil Hydrologic Function

Soil hydrologic function is the ability of the soil to absorb, store, and transmit water, both vertically and horizontally (USDA 2010b). Infiltration is the rate of water movement into the soil and is determined by soil; texture, cover, and porosity. Permeability is the rate at which water percolates or moves down through the soil and is primarily based on soil porosity.

Two measures used for the soil productivity indicator (effective soil cover and soil porosity and compaction) are also used as measures for the soil hydrology indicator. The litter layer of soil cover absorbs water, increases storage capacity, and slows the velocity of overland flow. Soil compaction can cause poor water infiltration, restricted percolation, and increased overland flow during high precipitation events (Poff 1996).

Effects Analysis

The effects analysis focuses on commercial mechanical salvage, resiliency harvest and roads. These activities tend to have the greatest affect to watershed resources and therefore the greatest potential for changing Watershed Condition Class score. Other mechanical and prescribed burning treatments, and pile and broadcast burning create fewer disturbances and have less potential to affect Watershed Condition Class score. The area analyzed for cumulative effects on soils and water resources is the 6th level HUC12 watersheds. The entire watershed is included because impacts to any area of the watershed can be transported in surface flow and impact downstream areas of the watershed as well as adjacent downstream watersheds. The temporal scope for this analysis includes both short-and long-term impacts. Short-term effects are defined that occur approximately within one to ten years following proposed vegetation treatments. Long-term effects are defined as those that occur approximately within 10 to 20 years, or more, following proposed vegetation treatments.

Analysis Assumptions include:

- Implementation will be relatively evenly distributed across the Opportunity Areas/watersheds for the three alternatives
- Forest Plan Standards and Guidelines will be followed (USDA Forest Service 1991c)
- Watershed Conservation Practices (FSH2509.25) will be followed (USDA Forest Service 2006a)
- National Best Management Practices for Water Quality Management on National Forest System Lands, Volume 1: National Core BMP Technical Guide (FS-990a) will be followed (USDA Forest Service 2012c)
- Design features would be implemented as designed. Project will follow state and federal laws; especially regarding construction in or near waterways and wetlands to control erosion.
- Sedimentation is the water-quality impairment most likely to result from the proposed activities. Roads, especially in close proximity to water are the dominant vector for sediment delivery to stream channels or wetland/fem resources.
- Potential changes in water yield are not quantifiable and will be based on the percentage of tree mortality within the watershed more than tree removal.

Alternative 1 (No Action Alternative – Direct and Indirect Effects

This alternative is used as a basis for comparing the effects of the Proposed Action and other alternatives. The No Action Alternative assumes that no implementation of any elements of the proposed action or other action alternatives would take place within the treatment area.

Alternative 1 effects would include:

- Natural processes would continue to result in high mortality in spruce-fir dominated stands.
- Aspen stands located in at-risk areas on the landscape may continue to decline.
- There could be plant community changes, such as shifts from forested to non-forested communities as a result of both spruce bark beetle and sudden aspen decline.
- Vegetation structure would change over time through natural growth and mortality and events such as wildfires, storms, and insect and disease outbreaks.
- Water yield in beetle-impacted watersheds could slowly increase as trees die and fall and spruce/aspen communities shift to stands dominated by aspen.
- Ecosystem processes such as insects and disease in trees would continue in their current trends.
- Safety concerns would increase.
- Some incidental tree removal would occur through firewood cutting permits.

It is important to note that the absence of management actions under this project does not mean that conditions in the area would remain static over time. This is related to the actions of nature coupled with the actions of humans. Because no treatments are proposed in this alternative, current conditions and existing trends in Watershed Condition Class, surface water quality, stream connectivity, floodplains, fens, wetlands, WIZs, soil productivity, physical characteristics, biological activity, and mass failure would continue.

Water yield changes in individual watersheds would be variable depending on the increasing number of beetle-killed trees reducing evapotranspiration and increasing ground-level snowpack. Surface organic matter would increase as beetle-killed trees fall and decay. Erosion would remain minimal where ground cover is sufficient and could decrease in other areas as beetle-killed trees continue to fall.

A potential major indirect effect of Alternative 1 is the increased risk of high severity fire due to increasing fuel loads. Although results of fire behavior modeling and studies of burned areas are not consistent, some results indicate that the potential for high severity fire is greater in areas with beetle-killed trees. Under Alternative 1, the acres of dead and dying trees will increase, providing more surface fuels on more acres for future fires. If proposed treatment areas were to be burned by wildfire in the future, a mix of burn severities would be anticipated depending on the topography, fuels, and climatic conditions. Moderate to high burn severities would likely result in an increase amount of bare soil, accelerated erosion, slow recovery of effective vegetation cover and loss of soil nutrients and soil microorganisms.

Large, high severity wildland fire occurring within a watershed could have sufficient negative effects to change the Watershed Condition Class score toward greater watershed impairment.

Effects of high severity fire may include increases in surface runoff and sediment transport to streams, increases in nutrients in streams, loss of soil structure, loss of soil biota, potential changes to stream flow timing and volume, and increases in water temperature in streams.

Alternative 1 – Cumulative Effects

There are no proposed management activities under Alternative 1. Therefore, no change to Watershed Condition Class scores or soil characteristics will result from the implementation No Action Alternative. The direct and indirect effects of natural processes in combination with past, on-going, and future activities could result in cumulative effects to watershed condition, municipal water supplies or soil characteristics. Grazing, recreation, road construction and maintenance and other vegetation treatments, could impact soil erosion potential, soil productivity and structure, water quality, and water quantity.

Direct and Indirect Effects Common to All Action Alternatives

Watershed

The types of treatments under Alternatives 2, 3, and 4 are the same but the size of opportunity areas and the potential miles of temporary and designed roads do vary. Alternative 3 focuses on WUI areas, which are closer to existing roads, reducing the total miles for temporary and designed roads in this alternative. Alternative 4 limits spruce treatments to salvage (no resiliency) and increases the total the commercial opportunity area. Thus, the direct, indirect, and cumulative effects of each action alternative on watershed and soils resources are similar and will be discussed once in this section. The maximum extent of opportunity areas is shown on Figure 16.

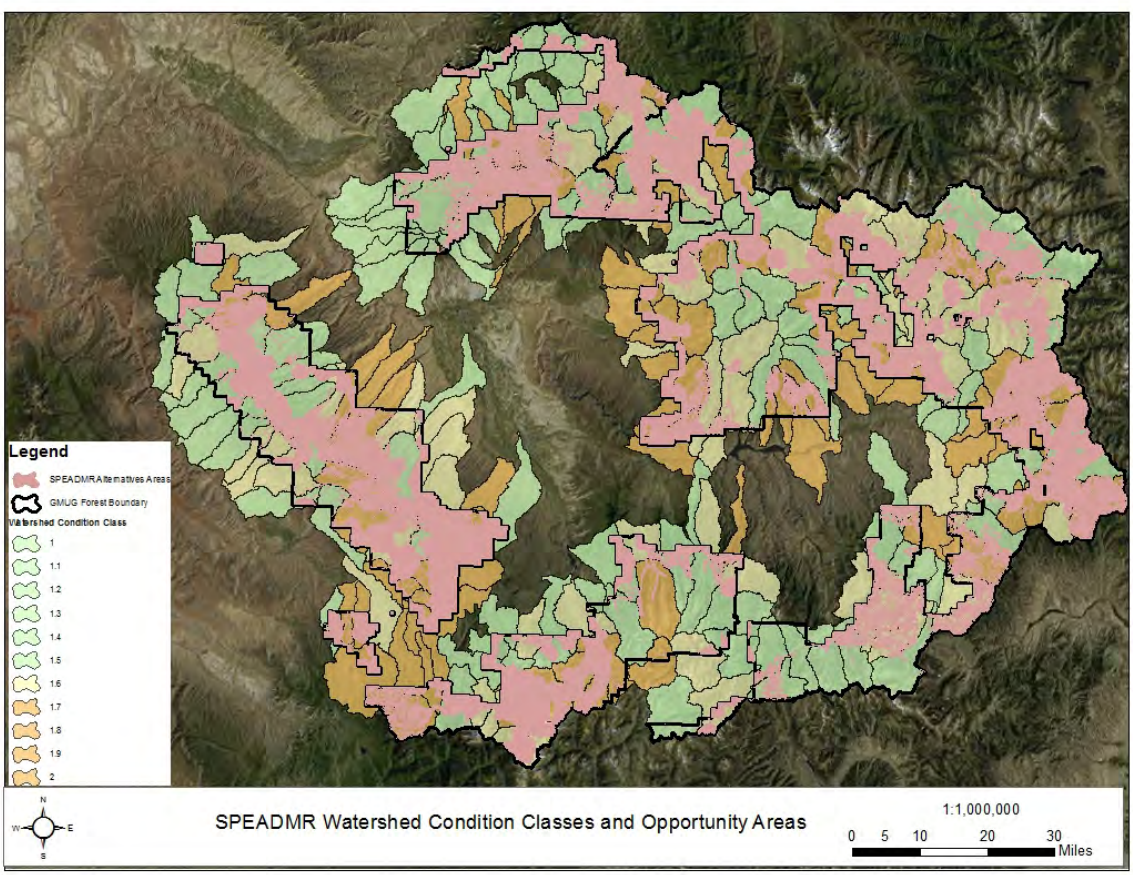


Figure 16. SBEADMR watershed condition class and maximum extent of opportunity areas.

Although the Opportunity Areas for each alternative range from 426,000 to 718,000 acres, GMUG proposes to treat up to approximately 6,000 acres annually with commercial harvest and approximately 6,000 additional acres of non-commercial mechanical treatments and prescribed burning for a total of approximately 120,000 acres treated over the life of the SBEADMR project.

Treatment-specific surveys listed in the Pre-treatment Design Checklist (Appendix C) will be completed during planning and development of a treatment. Survey data will guide placement of vegetation treatments, roads and skid trails. The Pre-treatment Design Checklist will also identify specific design features or BMPs to be applied. Lessons learned and corrective actions resulting from Annual Treatment Review will be applied to out-year projects through a continuous learning process (See Chapter 2 – Adaptive Implementation Approach).

Although all action alternatives include removal of dead and dying trees, the low number of proposed annual treated acres will not result in a significant reduction in the potential severity of large wildland fires. Large (thousands of acres or larger) high severity fires remove canopy and litter cover, resulting in increased erosion from lack of cover and increased water repellency in soils. Additional sediment delivery to streams negatively affects channel morphology and aquatic habitat. Nutrients are released into soils but nutrient loss also occurs due to volatization into the atmosphere and runoff into streams. Increased nutrients in streams negatively impacts water quality and aquatic habitat. If a large wildland fire occurred within a single watershed, it could move the affected watershed toward a more impaired condition.

All action alternatives include mechanical salvage harvest, mechanical fuels treatments, and prescribed burning treatments, including pile burning and broadcast burning, and varying lengths of temporary or design road construction. Mechanical salvage harvest and roads have the greatest potential disturbance to watersheds.

Although some watersheds have substantial Opportunity Area acres, actual treatments and roads are restricted to no more than 25 percent of the total watershed acres. This reduces the potential for measureable effects to the watersheds (USDA Forest Service 2006a, Eaglin 1993). The percent of individual watersheds included in Opportunity Areas is shown in the cumulative effects tables in Appendix C of the Watershed and Soils Specialist Report.

Mechanical Salvage Harvest, Resiliency Harvest, Non-commercial Cutting, and Coppice Cuts

Tree removal with mechanical harvest equipment disrupts soil surface structure and compacts soil in skid trails. Mechanical harvest equipment use is restricted to the outer half of WIZs, although equipment can reach into these areas. Harvest of beetle-killed trees could increase soil moisture, groundwater recharge, and plant available nutrients.

Use of design features and BMPs will reduce the potential for compaction and erosion. Objectives for specific design features are noted in the design feature list. Treatment-specific design features will be selected by a GMUG resource specialist during pre-implementation analysis. Examples of appropriate design features for this type of activity include but are not limited to:

- Maintaining or restoring ground cover to reduce erosion potential (WQSP-1).
- Keeping heavy equipment outside WIZs, fens, and wetlands to minimize damage (WQSP-4).
- Operating heavy equipment when the soil is dry or over a minimum one foot of snow to reduce soil compaction (WQSP-5, WQSP-9A).

The effects of individual treatments are likely to be minor to moderate and moderate term.

Roads

Designed/engineered or temporary roads must often be constructed in the treatment areas to allow access and remove trees. Road construction creates soil compaction and potentially impacts nearby streams. Roads can cause changes in surface and shallow subsurface hydrology and are often a major source of sediment to streams (Megahan 2000). Increases in road density and the number of road-stream crossings increase the potential for sediment delivery to streams and in changes to stream channel morphology.

The locations and lengths of proposed new temporary and designed roads will be determined during the treatment design phase and are only estimated for this document. Criteria would determine when roads would be needed to complete treatments, which would help limit road construction. Some existing roads located within WIZs or other sensitive areas may be moved and erosion control measures improved to reduce impacts to riparian areas and provide a beneficial effect to watersheds. New temporary and designed roads would be minimized and design features and BMPs implemented to reduce potential impacts. Pre-implementation surveys would identify WIZs, fens, wetlands, and geologically unstable areas in the proposed treatment areas. Locating roads outside of WIZs, fens and wetlands allows ground surface cover to act as a filter to eroded material and keep sediment out of waterbodies.

Examples of appropriate design features for this type of activity include but are not limited to:

- New designed and temporary road construction would not increase overall disturbance within the watershed to more than 25 percent of the watershed area (WQSP-10).
- Proposed roads would be located outside of fens and wetlands, and to the extent feasible, WIZs (WQSP-2, WQSP-4).
- Stream crossings would be minimized and constructed according to Forest Service standards to minimize negative impacts to stream channels and aquatic habitat (WQSP-3A).
- All new temporary roads and at least 80 percent of new designed roads would be decommissioned at project completion (WQSP-8A, WQSP-8B)

The estimated road lengths presented in this document are a maximum estimate of miles of road that could be constructed. Due to the cost of road construction, and to minimize environmental impacts, every attempt would be made to minimize additional road construction. For the purpose of estimating the area of disturbance, the maximum estimate of acres of roads was calculated and the percent watershed disturbance calculated. The highest percent of potential watershed disturbance from new roads is 0.5 percent. All new temporary roads and approximately 80 percent of designed roads would be decommissioned after project completion. The effects of new roads would likely be minor and short-term.

Mechanical and Hand Fuels Treatments

Mechanical fuels treatment consists of mastication. Masticators are heavy pieces of equipment that shred understory vegetation and small trees and which are typically driven over the masticated material which reduces ground disturbance and soil compaction. The shredded vegetation remains on the soil surface, which minimizes or eliminates erosion. Masticated material is typically burned within a few years, which releases nutrients to the soil.

Examples of design features appropriate for this type of activity include, but are not limited to:

- Operating heavy equipment on dry soils to minimize soil compaction (WQSP-9A).
- Leaving 80 percent cover in WIZs (WQSP-2).
- Avoiding operating equipment in fens and wetlands (WQSP-4).

Hand treatments, which include thinning or pruning with chain saws, and hand piling and burning slash, create virtually imperceptible disturbance at the watershed level.

Broadcast and Pile Burning

Broadcast burning is a prescribed fire technique that creates patchy, low to moderate severity impacts to surface soils. Burning is conducted when soils and fuels have higher moisture levels which reduce fire impacts to soils. Patchy burn patterns leave relatively bare areas surrounded by unburned or slightly burned areas with sufficient cover to reduce runoff and erosion potential.

This type of broadcast burning has effects which are generally localized, minor and short-term (McIver 2013, Erickson 2008).

Broadcast burning will conducted to create suitable conditions for aspen regeneration. Damage to soils can occur where the fire burns hotter or for longer time periods, such as where fuels are larger or denser. Where fire severity is high, the fire may burn all surface cover in some areas, can create areas of water repellent soils, and damage the soil biotic community. These areas are typically patchy and surrounded by areas of partial soil cover and less damaged soil, which reduces the potential for significant erosion and allows the soil to recover.

Pile burns can damage soil structure, productivity, and soil biota, but can be effectively rehabilitated through scarification and mulching (Jiménez Esquilín 2007, Fornwalt 2011). Pile burns effects will be localized, moderate, and short-term.

Watershed Condition Class

Watersheds with the highest levels of existing and potential disturbance are at a greater risk of reducing Watershed Condition Class score due to treatment activities. Proposed mechanical harvest treatment could have negative effects on nearly all of the twelve Watershed Condition Class indicators unless design features and BMPs are implemented appropriately. The level of risk will be evaluated for all proposed units on a treatment-specific basis by GMUG resource staff following the Pre-Treatment Checklist prior to implementation.

However, unless multiple consecutive years of treatments are conducted within the same watershed, the effects of the treatments are unlikely to change the Watershed Condition Class score. Funding and personnel availability limit the number of acres that can be realistically treated annually. Design features limit road density and at least 80 percent of new design and temporary roads will be decommissioned when each project has been completed. The relatively small number of acres treated annually, the use of the Checklist, design features and BMPs, make it unlikely that the score would be changed by any one treatment within a watershed.

Mechanical timber harvest, non-commercial mechanical cutting, and roads have the greatest potential disturbance effects to watersheds (Jones 2000, Gucinski 2001). The magnitude of disturbance depends on the number and location of acres treated, the type of equipment used, and the use of design features and BMPs. Implementation of appropriate design features and BMPs will reduce the potential for impacts to acceptable levels. If pre-implementation surveys and effects analyses indicate a potential for negative effects sufficient to change the Watershed Condition Class score, the proposed treatments will be modified to reduce the effects to maintain watershed conditions.

Mechanical treatments and prescribed fire, with the use of appropriate design features and BMPs, create less damaging disturbances to the watershed and are unlikely to cause a change in Watershed Condition Class score.

The potential for negative or positive effects from the proposed treatments increases if treatments are concentrated within a single watershed. Treatments covering less than 25 percent of a watershed should not have sufficient impacts, especially with implementation of design features and BMPs, to change the Watershed Condition Class score (USDA Forest Service, 2006b). Even where larger areas of the watershed are being treated, design features and BMPs reduce impacts, although some negative impacts could occur if large areas of treatments take place within a few years in the same watershed. Some watersheds include total possible Opportunity Area acres that cover more than 25 percent of the watershed; however, most of these watersheds also include limitations on treatment acres within Lynx Habitat Units, which would reduce the total percentage of treatment areas within the watershed. In addition, the Checklist restricts disturbances to less than 25 percent of the total watershed acreage. This reduces the potential for negative impacts sufficient to change the Watershed Condition Class score.

The potential for negative effects from the proposed treatments is influenced by the type of treatment. Mechanical treatments and roads can have negative impacts to surface water quality and stream connectivity. Erosion from mechanical harvest areas and roads can deliver sediments to streams. Stream crossings can also release sediments and prevent aquatic life passage if improperly constructed. Use of design features and BMPs should reduce the potential for these impacts to minor and short-term.

Water yield response to the proposed treatments is likely to be variable (Pugh 2012, Troendle 2000). Typically, water yield increases after timber harvest due to reduced canopy interception and evapotranspiration, and increased snowpack on the cleared ground. Many trees in the treatment areas are already dead or dying so evapotranspiration has already been reduced but the trees are still standing so canopy interception still occurs to some extent and clearings are lacking, reducing snowpack on the ground. While proposed treatments will create clearings and reduce interception, the changes will be variable at the watershed level and it is likely that the proposed treatments will not result in a detectable change in water yield due to the relatively small treated areas within the entire watershed.

Mechanical treatments and prescribed burns are very restricted within WIZs and riparian areas, and excluded from fens and wetlands. Pre-implementation surveys will identify these areas and the treatment area will be modified as needed to minimize impacts. Design features minimize the presence of equipment within WIZs and impacted areas, such as road/stream crossings, will be rehabilitated after project completion.

Pile burning will not occur in WIZs and broadcast burns may be allowed to back into WIZs. WIZs can contain high fuel loads and can benefit from fuels reduction treatments. Design features will be selected to maintain sufficient canopy and ground cover but still permit some treatments within the WIZ. WIZs recover quickly from burning so impacts from broadcast burning to WIZs is anticipated to be short term and minor (Bêche 2005, Bisson 2003, Dwire 2003, Kobziar 2006).

Municipal Supply Watersheds

The direct and indirect effects on water quantity and quality in municipal supply watersheds are described in the Watershed Condition Class section. Changes in volume and timing of stream flows would be variable and based on a number of factors differ for each watershed, including watershed size, location, general aspect, localized climate, and percentage of beetle-killed trees. Disturbances due to proposed treatments and roads would be limited to no more than 25 percent of the watershed area and so would not have measureable effects on water yield.

Water quality would not likely be affected due to the small percentage of watershed disturbance and the use of design features and BMPs to reduce the potential for erosion and sediment transport to streams.

Direct and indirect effects to municipal water supplies would be negligible and short-term.

Soils

Soils can be directly impacted by heavy equipment, tree harvest activities, road building, and large pile burning. Removal of surface and canopy cover, as well as surface disturbance can result in increased erosion and sediment transport. This is especially likely in area with severe or very severe erosion hazard ratings (EHR). These soils are typically on steep slopes (greather than 40%) and are very erodible. The mechanical equipment and road construction required for salvage harvest, resiliency treatments, and non-commercial cutting are likely to have the greatest effect on soils in the treatment areas. The harvest equipment used causes disturbance to the soils surface layer, disrupting soil structure and biological activity, compacting the surface, and creating the potential for increased erosion. Timber cutting will also leave biomass in the form of slash on the ground which reduces erosion potential and provides a source of soil nutrients as it decays.

Roads compact soils and interfere with surface and shallow subsurface water flow. Roads are a source of sediments that may be deposited in nearby streams. Road crossings can change stream channel structure, provide sediment to the stream and prevent or inhibit aquatic organism passage.

Pre-implementation surveys and effects analyses will be conducted and appropriate design features and BMPs selected to minimize the potential for adverse effects. Some examples of appropriate design features for these activities are listed previously in this document. The effects of mechanical harvest are likely to be localized, moderate, and short-term. The effects of roads are likely to be localized, minor, and moderate to long-term.

Mechanical fuels treatments, i.e. mastication, cause less compaction and disturbance than mechanical harvest and roads, and leave vegetative material on the ground which provides some erosion control and soil nutrients as it decays. Mechanical fuels treatments result in fewer disturbances, as described in the previous section and are likely to have localized, minor, and short-term effects on soils.

Hand fuels treatments occur over the smallest areas and leave some vegetative material on the ground. Hand treatments cause minimal compaction and disturbance to surface soils. Hand fuels treatments are likely to have insignificant effects on soils.

Pile burning creates disturbance in surface soils, changes in soil structure and composition, and reduction and changes in the soil biotic community. Burn pile locations can be rehabilitated by ripping, seeding, and mulching. This encourages growth of native vegetation and reduces the potential for invasive plant species to grow. The recent large rock avalanche in Mesa County shows the potential for mass failure within the GMUG. The proposed treatments are unlikely to contribute to a mass failure of this size, but could influence smaller areas. Landslide potential is included as part of the pre-implementation surveys and treatment areas will be located outside of identified slope failures.

Pre-Treatment Checklist

The Pre-Treatment Checklist was developed to assist in the planning of individual treatment areas. The Checklist identifies surveys and on-the-ground reviews required by law, regulation or policy. This data will be used to develop treatment-specific treatments areas and will establish treatment-specific objectives. See Appendix C.

Design Features

Common to all action alternatives, design features are presented in

Table 15 and Appendix B and were developed to conserve and protect the hydrologic and soils resources during the implementation of the SBEADMR Project. The majority of the design features are from the Forest Plan Standards and Guidelines, the Region 2 Watershed Conservation Practices Handbook, National Best Management Practices for Water Quality Management on National Forest System Lands, and Best Management Practices developed by the state of Colorado.

Table 15. Design Features for Soil and Water Resources.

Design Feature	Trigger for Use	Description	Effect
WQSP-1	All mechanical (ground-based) activity	Maintain the organic ground cover of each activity area so that pedestals, rills, and surface runoff from the activity area are not increased.	Ensures maintenance of organic ground cover for purposes of soil function and reduced erosion
WQSP-2	All mechanical (ground-based) activity	Keep heavy equipment out of streams, swales, and wetlands.	Reduces excessive sedimentation which reduces water quality and stream health and decreases fen/wetland function for watershed health
WQSP-3A	Construction of temporary roads	Coordinate with engineers and forest hydrologist and fisheries biologist to ensure crossings are constructed to minimize streambank disturbance and sediment mobilization, allow for the passage of flood flows, debris and aquatic organisms for the life of the structure and crossing	Reduces excessive sedimentation which reduces water quality and stream health and decreases fen/wetland function for watershed health
WQSP-3B	Construction of temporary roads	Temporary roads and at least 80 % of design roads will be decommissioned	Reduces excessive sedimentation which reduces water quality and stream health and decreases fen/wetland function for watershed health
WQSP-4	All mechanical (ground-based) activity	Keep ground vehicles out of wetlands	Reduces excessive sedimentation which reduces water quality and stream health and decreases fen/wetland function for watershed health
WQSP-5A	All mechanical (ground-based) activity	Limit detrimental soil disturbance to less than 15% of any activity area	Reduces compacted areas and maintains soil porosity, which is vital to maintain soil and hydrologic function
WQSP-5B	All mechanical (ground-based) activity	Ground based equipment will be operated only when dry soil conditions exist i.e., soil is below the plastic limit or frozen conditions, i.e. at least 6 inches of frozen soil or at least 1 foot of packed snow is present	Reduces compaction and maintains soil porosity, which is vital to maintain soil and hydrologic function
WQSP-6	Construction of temporary roads	Design all roads, trails, and other soil disturbances to the minimum standard for their use	Reduces excessive sedimentation which reduces water quality and stream health and decreases fen/wetland function for watershed health
WQSP-7A	Construction of temporary roads	Minimize fill in floodplains to assure crossings allow flood flows to pass with minimal interruption	Reduces excessive sedimentation which reduces water quality and stream health and decreases fen/wetland function for watershed health

Design Feature	Trigger for Use	Description	Effect
WQSP-7B	All mechanical (ground-based) activity	Limit detrimental soil disturbance to less than 15% of any activity area	Reduces compacted areas and maintains soil porosity, which is vital to maintain soil and hydrologic function
WQSP-9A	Construction of temporary roads	Limit detrimental soil disturbance to less than 15% of any activity area	Reduces excessive sedimentation which reduces water quality and stream health and decreases fen/wetland function for watershed health. Reduces compacted areas and maintains soil porosity, which is vital to maintain soil and hydrologic function
WQSP-9B,F	Prescribed burning	Conduct prescribed burning when the forest floor is moist. Avoid building firelines in or around riparian areas, wetlands, fens or other sensitive water-dependent sites	Limits areas of soil hydrophobicity which increases surface water flow and erosion.
WQSP-9C,E	Prescribed burning	Maintain the organic ground cover of each activity area so that pedestals, rills, and surface runoff from the activity area are not increased. Prompt re-vegetation with an approved weed-free seed mix.	Ensures maintenance of organic ground cover for purposes of soil function and reduced erosion
WQSP-9D	All mechanical (ground-based) activity	Limit mechanical earth moving to slopes less than 30%.	Slopes greater than 30% have greater chance of slipping/slumping and eroding.
WQSP-10	All mechanical (ground-based) activity	Maintain disturbance acres from mechanical harvest and roads to less than 25 percent of the HUC12 area.	Maintains or improves watershed condition and current health.
WFRP-3	All mechanical ground-based activity	Maintain 10 to 20 tons per acre of coarse woody debris within treatment units	Ensures maintenance of organic ground cover for purposes of soil function and reduced erosion

Alternative 2 (Proposed Action) – Direct and Indirect Effects

There are approximately 718,000 acres of opportunity areas included in the Proposed Action. The direct effects of the Proposed Action include potential disturbance to stream channels, WIZs, and soils due to road construction and heavy equipment use.

Detrimental soil disturbances are described in a previous section of this document. Over the long-term, soils affected by detrimental disturbance on main skid trails would recover through natural processes, such as frost heave, bio-perturbation and soil organic material cycling.

Reclamation of skid trails through soil scarification, seeding, and placement of woody debris (slash), would promote recovery of soils in the long-term.

Pre-implementation surveys and effects tracking will be conducted according to the Checklist for soils and water, and appropriate design features selected for each treatment area. Surveys will identify areas of concern to be avoided, such as fens or wetlands, and effects tracking will evaluate potential adverse or beneficial effects of the proposed treatment. Cumulative effects tracking will evaluate the potential for undesirable cumulative effects. If treatment-specific surveys indicate that the treatment could move the watershed toward a more impaired condition, the proposed treatment may be modified. Design features will be used as necessary to minimize potential adverse effects.

Use of appropriate design features would result in direct effects of proposed treatments ranging from insignificant to moderate, localized, and short to moderate term. Although it is unlikely that proposed treatments will result in a change in Watershed Condition Class score, treatment-specific analysis will be conducted to evaluate the potential for change.

As part of adaptive management, design feature effectiveness monitoring will be conducted on one randomly selected treatment unit per year, per Forest (for a total of three). If needed, treatments or design features for later projects can be modified to reduce negative effects.

Indirect effects of the Proposed Action are described in a previous section discussing effects common to all alternatives.

As with the direct effects, pre-treatment surveys and effects tracking, selection and implementation of design features and BMPs, limitations on percentage of watershed treated in design features and watersheds with Lynx Habitat Units, and rehabilitation of new roads will be conducted to minimize adverse effects. Indirect effects of proposed treatments should range from insignificant to moderate, localized, and short to moderate term.

Alternative 3 (Public Safety) – Direct and Indirect Effects

There are approximately 426,000 acres of opportunity areas included in Alternative 3. The same annual limitations on total acres treated as in the Proposed Action apply to Alternative 3.

Because Alternative 3 focuses on treatments within the Wildland Urban Interface (WUI) and closer to existing roads, there are likely to be fewer new roads, skid trails, and road-stream crossings. This would reduce direct effects from roads and road-stream crossings. There would also be fewer acres of mechanical harvest with accompanying skid trails, landings, and temporary roads.

The same pre-implementation surveys as for the Proposed Action would be conducted with appropriate design features selected for each treatment unit. Units would be modified if needed to comply with design features and Checklist requirements. As part of adaptive management, BMP effectiveness monitoring will be conducted on one randomly selected unit per year. If needed, treatments or design features for later projects can be modified to reduce negative effects.

Direct effects of proposed treatments should range from insignificant to moderate, localized, and short to moderate term. Although it is unlikely that proposed treatments will result in a change in Watershed Condition Class score, treatment-specific analysis will be conducted to evaluate the potential for change.

As described above, indirect effects of Alternative 3 include soil erosion, especially in areas with severe or very severe EHR; sediment delivery to streams with resulting impacts to water quality; and possible changes in water yield.

As with the direct effects, pre-treatment surveys, effects and cumulative effects tracking, and selection and implementation of design features will be conducted to minimize adverse effects. Indirect effects of proposed treatments should range from insignificant to moderate, localized, and short to moderate term.

Alternative 4 (Spruce-fir Salvage Only) – Direct and Indirect Effects

There are approximately 718,000 acres of opportunity areas included in Alternative 4 which focuses on spruce/fir salvage only. Resiliency treatments are not included. This alternative includes additional acreages within LAUs that increase the total number of commercial opportunity area acres. The other proposed treatments are the same as in the Proposed Action.

The direct effects of Alternative 4 include potential disturbance to stream channels, WIZs, and soils due to road construction and heavy equipment use.

Because Alternative 4 does not include resiliency treatment, the effects of salvage harvest may be greater than in Alternative 2. Salvage harvest removes trees from larger areas and generally requires more new roads, skid trails, skid roads, and road-stream crossings than resiliency harvest. Harvest equipment must make more trips to cut and haul timber, causing more soil disturbance and compaction. Use of design features is necessary to minimize these impacts.

Direct effects of proposed treatments should range from insignificant to moderate, localized, and short to moderate term. Although it is unlikely that proposed treatments will result in a change in Watershed Condition Class score, treatment-specific analysis will be conducted to evaluate the potential for change.

As part of adaptive management, design feature effectiveness monitoring will be conducted on one randomly selected treatment unit per year, per Forest unit (for a total of three). If needed, treatments or design features for later projects can be modified to reduce negative effects.

As described above, indirect effects of Alternative 4 include soil erosion, especially in areas with severe or very severe EHR; sediment delivery to streams with resulting impacts to water quality; and possible changes in water yield.

As with the direct effects, pre-implementation surveys, effects and cumulative effects analyses; selection and implementation of design features and BMPs; limitations on percentage of watershed to be treated and decommissioning at least 80% of new designed and 100% of temporary roads would minimize adverse effects. Indirect effects of proposed treatments should range from insignificant to moderate, localized, and short to moderate term.

Cumulative Effects Common to All Action Alternatives

Cumulative effects include past, ongoing, and foreseeable future activities. A table of selected past (timber harvest) and ongoing (grazing, roads) are available in the project record, including maximum proposed areas for proposed treatments and new roads. Generally, however, past actions are reflected in the environmental baseline described above.

Most vegetation treatments employ similar design features to protect watersheds as identified in Appendix B that have proven to be effective. However, in general, watersheds with the highest percentages of disturbed areas would be most at risk for additional impacts to change Watershed Condition Class score. Therefore, treatment-specific cumulative effects tracking would be conducted prior to implementation of all proposed treatments to ensure compliance with the design feature WQSP-10. This design feature limits treatments to 25 percent disturbed area acreages within each watershed. Disturbances within this threshold are unlikely to affect watersheds sufficiently to change Watershed Condition Class score. Most of the watersheds within the project area also include Lynx Habitat Units, with additional limitations on number of acres available for treatments, further reducing the potential cumulative effects.

Cumulative effects would be similar across all action alternatives. Effects in Alternative 3 would be more concentrated within the WUI relative to Alternatives 2 and 4, and Alternative 4 would likely have more potential for impacts associated with timber salvage.

Transportation

The Forest transportation system is essential for implementation of the proposed vegetation treatments. Road treatments are also proposed to accommodate the action alternatives.

Compliance with Direction

Action alternatives meet applicable law, regulation, and policy by maintaining the existing forest transportation system, using treatment design features to minimize effects and ensure compliance with direction during implementation, taking action to provide for user and worker safety, and adding minimum but necessary new access routes while not increasing public access. The treatment would follow all applicable federal and state laws, regulations and policies to the fullest extent that they are known, understood and interpreted by resource managers.

Federal laws guiding this project include the National Forest Roads and Trails Act of 1964, as amended (16 U.S.C. 532-538), the Highway Safety Act of 1966 (23 U.S.C. 402), National Trails System Act of October 2, 1968 (16 U.S.C. 1241-1249), Surface Transportation Assistance Act of 1978, as amended (23 U.S.C. 101a, 201-205), Annual Department of the Interior, Environment, and Related Agencies Appropriations Act, and the Organic Administration Act of 1897 (16 U.S.C. 551).

Federal regulations include:

- Travel Management (36 CFR Part 212, Subparts A, B, and C) - Establishes requirements for the administration of the forest transportation system, and identification of the minimum road system needed.[4]
- Prohibitions (36 CFR Part 261, Subpart A) – Establishes prohibitions on use of NFS lands, including prohibitions on possession and operation of motor vehicles on NFS roads, on NFS trails, and in areas on NFS lands.
- Sale and Disposal of National Forest System Timber (36 CFR Part 223) - regulates road construction related to Forest Service timber sale appraisals and contracts.

Forestry Best Management Practices are provided by the Colorado State Forest Service.

Forest Service direction on travel management is found in Forest Service Manual (FSM) 7700, which addresses planning, construction, reconstruction, operation, and maintenance of forest transportation facilities and management of motor vehicle use on NFS lands. In addition, the following Forest Service Handbooks provide further guidance: FSH 7709.55, Travel Planning Handbook; FSH 7709.56, Road Preconstruction Handbook; FSH 7709.56b, Transportation Structures Handbook; FSH 7709.57, Road Construction Handbook; and, FSH 7709.59, Road System Operations and Maintenance Handbook. National and Regional Best Management

[4] Travel plans exist for each of the national forests within the GMUG. These travel plans would be amended if any changes to allowed motor vehicle use were to occur under the SBEADMR Project.

Practices are applicable to this Project. Regional BMPs are included in the FS directives under FSH 2509.25.

Forest Plan direction associated with roads and pertinent to the SBEADMR project is identified below. This summary does not include directives applicable to unique Forest Plan management areas. Review and accordance with these individual management areas is required; see the Transportation System and Haul Routes Design Features (Table 23) below.

Pertinent1983 and 1991 Amended Land and Resource Management Plan direction includes:

- Provide a safe, efficient and environmentally sound transportation system.
- Update existing facilities and structures to meet State and Federal standards.
- Closed or restricted roads may be used for and to accomplish administrative purposes when:
    a. Prescribed in management area direction statements;
    b. Authorized by the Forest Supervisor; and
    c. In case of emergency.
- Construct and reconstruct local roads to provide access for specific resource activities such as campground, trailheads, timber sales, range allotments, mineral leases, etc, with the minimum amount of earthwork.
- Construct temporary roads for specific resource activities such as timber sales, emergencies, (e g. fire suppression), or mineral exploration. Roads needed beyond the timber sale or minerals exploration activity shall be specified roads (i.e., not temporary).
- Temporary roads shall not be designated as Forest development transportation facilities and shall not be recorded in the transportation inventory system.
- All temporary roads shall be obliterated as defined by the Forest Plan Glossary. Ninety percent of the obliterated temporary road mileage will not have sustained use three years after obliteration.
    - Rehabilitation Standards for temporary roads · Return to resource production within one year from cessation of activities.
- Maintain all roads to the following minimum requirements:
    - All paved roads - Level 5·
    - All arterial and open collectors- Level 3,
    - All open local roads - Level 2, and
    - All closed roads - Level 1
        - Level 1 maintenance includes upkeep of drainage structures and vegetation cover necessary to prevent erosion.
- Maintain structures, bridges, cattleguards, etc. to be structurally sound and safe for use

Table 16. Road Construction and Reconstruction Standards

Standard	Travel Speeds	Lanes	Surface	Width	Drainage
Arterial	Avg. 35-55 mph	Generally 2	All weather, generally asphalt or gravel	Typically 20 to 24 feet, but some single lane with intervisible 10-foot turnouts	Permanent, not to impede traffic
Collector	Avg. 10-30 mph	Generally 1	Generally gravel or native surface, sometimes asphalt	Permanent not to impede traffic	Permanent, but may impede traffic
Local	Average less than 20 mph	Usually single lane except for developed recreation sites	Varies from asphalt to native surface, majority native surface	Typically 10 thru 14 Feet; Turnouts optional depending upon traffic management; usually not intervisible	Dips and culverts
Temporary	Less Than 10 mph	Single	Usually native	Typically 10 thru 14 feet; the minimum width is desired to minimize surface disturbance	Drain dips, low water crossings, culverts

Pertinent direction from the Southern Rockies Lynx Amendment (2008) is addressed in the wildlife section.

Analysis Methodology

Assumptions Specific to Transportation

- The Forest transportation system, as documented and inventoried by the Forest transportation atlas, is the primary data used to summarize this effects analysis. The transportation atlas includes both public and administrative routes. All distance figures are approximate values based on the Forest transportation atlas (including spatial GIS data and tabular INFRA data) and are limited to the accuracy of those sources which includes measurements from GIS, GPS, field instruments and aerial photography. Mileages may change slightly with additional field verification and treatment implementation.
- All road work and infrastructure improvements would be conducted in accordance with the Treatment Design Features.

- The spatial boundary and subject for analysis includes all National Forest System lands administered by the GMUG, as well as National Forest System roads and other public roads open to vehicle use.
- Effects are assessed based on a 15-year time frame, assuming all treatment actions associated with the transportation network would be completed by that time. In this report, "short-term" is considered less than this, while "long-term" is considered beyond this period. A 5-year window was added to the end of the 10-year vegetation implementation time frame to allow for post-vegetation treatment road work to be finalized.
- Transportation actions by alternative were developed using the following assumptions:
  - Over the life of this project, the Forest is capable of implementing 60,000 acres of commercial mechanical harvests, including roadside danger tree mitigation and public safety treatments. This acreage was assumed for all action alternatives.
  - For Alternatives 2 and 4, likely mechanical vegetation treatments would be within 1 mile of existing operational maintenance level 3-5 NFS roads.
  - For Alternative 3, likely mechanical vegetation treatments would be within ¼ mile of existing operational maintenance level 3-5 NFS roads.

Mileages for designed road construction and temporary road construction are based on Forest available data for timber sales occurring over the past 5 years (Table 17).

Table 17. GMUG Timber Sale Averages from the Past 5 Years - Volumes and Acreages per Mile of Road Activity

Zone	Avg. CCF/Acre	1 mile Temporary Road Construct-ion (CCF)	1 mile Road Reconstru-ction (CCF)	1 mile Designed Road Construct-ion (CCF)	1 mile Temp Road Construct-ion. (Acre)	1 mile Road Reconstruct-ion (Acre)	1 mile Designed Road Construct-ion (Acre)
North	17.0	2,359	4,139	9,882	139	244	582
East	10.8	2,359	2,436	12,632	218	225	1,165
West	11.7	1,893	Not available	Not available	162	Not available	Not available
AVG.	Not available	2,204	3,288	11,257	173	235	874

Adjustments were then made as follows:

- For treatments in the WUI and in roadside corridors, a higher density of existing roads would limit associated need for new construction. Therefore, it is assumed that one mile of temporary road would be constructed for approximately 2000 acres These temporary roads would be decommissioned after use.
- New access roads for recovery and resiliency treatments beyond ¼ mile of existing operational maintenance level 3-5 NFS roads would match the Forest construction average using timber sale data from the past 5 years.
- New access roads for recovery and resiliency treatments beyond 300 feet but less than ¼ mile of existing operational maintenance level 3-5 NFS roads would be ¼ of the Forest construction average using timber sale data from the past 5 years.
- Road reconstruction would occur at the rate of 1 mile for every 230 acres of treatment (based on the Forest 5-year data).
- Under Alternatives 2 and 4, 50% of all operational maintenance level 3-5 roads within treatments would be used for treatment access and maintained.
- Under Alternatives 2 and 4, 20% of operational maintenance level 1-2 roads within treatments would be used for treatment access and maintained or reconstructed.
- Under Alternative 3, 75% of all operational maintenance level 3-5 roads within treatments would be used for treatment access and maintained.
- Under Alternative 3, 20% of operational maintenance level 1-2 roads within treatments would be used for treatment access and maintained or reconstructed. This was adjusted assuming treatments under this Alternative would prioritize higher standard roads (ML 3-5).
- Alternatives 2 and 4 use the same mileage estimates.

Data Sources

The Forest transportation atlas includes roads and motorized trail information as contained in geographic information system (GIS) spatial data and Forest Service Infrastructure (INFRA) tabular data.

Transportation Indicators

Indicators used in the analysis of transportation effects include summaries of road work and associated impacts to the Forest transportation system. Key indicators include:

- Forest transportation system conditions
- Traffic
- Health and safety
- Qualitative effects summary based on a scale from beneficial to adverse

Affected Environment

The GMUG has a large and diverse road network. This system was developed over time in part to provide for access and utilization of NFS lands. Long established needs for access roads include mining, timber, range, and recreation.

Currently the GMUG manages over 3,600 miles of NFS roads. The majority of these, nearly 2,500 miles, are low standard, single-purpose roads available for high clearance vehicles (operational maintenance level 2). A breakdown of NFS roads on the GMUG is presented below.

Table 18. GMUG-managed NFS Roads.

Operational Maintenance Level	Description	Count	Miles
1 – Basic Custodial Care (Closed)	Intermittent use road while placed in storage; closed to all mechanized travel but not decommissioned	322	309.6
2 – High Clearance Vehicles	High clearance vehicle use	1895	2471.4
3 – Suitable for Passenger Cars	Maintained for travel by prudent driver in standard passenger car	308	586.8
4 – Moderate Fegree of User Comfort	Moderate degree of user comfort and convenience at moderate travel speeds	64	254.9
5 – High Degree of User Comfort	High degree of user comfort and convenience	44	13.7
**Operational maintenance levels 2-5 summarized here also include administrative use roads not open to public use*			

A number of other routes are included in the project area. Many of these are public roads managed and under jurisdictions other than the Forest Service. There are also additional roads under Forest Service jurisdiction that exist on the landscape, and not managed as part of the Forest transportation system. These include roads associated with some sort of authorized use (agreement, permit, right-of-way), as well as unauthorized routes. These unauthorized roads can be user-created or a remnant of past management activity.

Last of all, there are public roads managed by public road authorities that access potential treatments. This includes major US highways, Colorado DOT managed highways, county roads, and municipal roads. There are also roads managed by other federal agencies, including the Bureau of Land Management and the Bureau of Reclamation.

Roads of various jurisdictions within the project area have had increasing roadside danger trees (see Figure 17) over time, due to spruce beetle and aspen decline.

Figure 17. Dead and dying spruce along the the Los Pinos to Cebolla NFS Road in the GMUG

A widespread road network would be necessary to access and manage NFS lands to achieve the goals of the SBEADMR project. Specifically applicable to roads, mitigating high priority roadside danger trees is needed in order to provide a safe, efficient and environmentally sound transportation system. Management of existing and new roads in accordance with current direction is desired. This would support achievement of the SBEADMR project goals while also providing for efficient and sustainable road management.

Alternative 1 (No Action) – Direct and Indirect Effects

Alternative 1, the No Action Alternative, is used as a basis for comparing the effects of the Proposed Action and other alternatives. It assumes no implementation of any elements of the Proposed Action or the Action Alternatives. There would be no direct effects from Alternative 1 to the transportation system.

Under Alternative 1, indirect effects include dead and dying trees falling across roads, blocking access and reducing road user safety. This may reduce access and may limit the long-term ability

to manage and maintain portions of the Forest transportation system within the project area. It could also result in a more dangerous, inaccessible, underutilized, and undermanaged network leading to adverse resource impacts including improperly functioning road drainage systems due to lack of maintenance.

Without the opportunity to utilize revenue from sales of salvaged timber, portions of the Forest transportation system would not receive maintenance and improvement treatments associated with implementation of the SBEADMR Project.

Alternative 1 – Cumulative Effects

Implementation of other approved projects would continue to occur and include uses associated with the Forest transportation system such as forest management activities including range management, minerals extraction, timber sales, vegetation treatments, permitted users and recreation and other uses by the public.

Annual road maintenance would continue to occur, with a priority placed on passenger car roads (maintenance level 3-5). However, a road maintenance backlog exists across the GMUG. The majority of maintenance level 2 roads would not be maintained, except in areas where ongoing and future authorized activities occur. Although vegetation management activities would proceed via other authorized decisions, the scope of these activities would be smaller, such that fewer roads would be maintained in the No Action compared to the action alternatives. Road deterioration would continue to occur through use. Due to increasing population and recreationists in the project vicinity, there is associated increased demand for public lands recreation; increased use of the Forest by the public would require continual evaluation of maintenance level of roads within the system and may prioritize maintenance needs for annual maintenance activities. The indirect effects of dead and dying trees falling across roads could result in the short-term blockage of access/egress and increased risks to immediate driver safety relative to the action alternatives.

Existing travel management decisions would continue to be implemented.

Activities Common to All Action Alternatives

Primarily the existing road network would be used to access the proposed treatments and also remove forest products, supplemented with designed and temporary road construction.

The management of treatment roads will be addressed through the use of design features, discussed below. At least 80% of designed roads and 100% of temporary roads constructed under any action alternative would be decommissioned upon completion of the project.

Road Work Descriptions

Maintenance

Roads being used for treatments that are in good condition would be maintained during treatment implementation. Maintenance preserves the function of the road but generally does not include improvements. Maintenance activities generally include: blading; roadside brushing; removal of individual roadside hazard trees outside treatment units; repair and/or replacement of road surfaces; cleaning, repair, or installation of drainage structures such as culverts, ditches, and dips; dust abatement; snow plowing; removal and installation of closure barriers, and installation or repair of signs. Maintenance activities generally do not disturb ground outside the existing roadway (toe of fill to top of cut) other than removal of material around culvert inlets and cleaning of outlet ditches.

It is assumed that a majority of higher standard system roads (operational maintenance levels 3-5) used for treatment access and forest product removal would receive maintenance. A majority of these high standard roads are under maintenance agreements with counties; coordination will be needed with these agencies.

Frequent haul will wear out surface rock, eventually requiring surface replacement work to occur. A common rule of thumb is that gravel wears at the rate of 1 inch for every 10 million board feet (approximately 22,000 CCF) hauled. For road maintenace activities, user safety, drainage, and structural integrity of the road are the priority objectives.

Reconstruction

Reconstruction generally includes work to improve and restore roads, or to bring them back up to the original design standard. Improvements would provide for serviceability for treatment haul vehicles, as well as for proper hydrologic function and stream protection in accordance with applicable Best Management Practices. Actions can include surface improvement; construction of drainage dips, culverts, riprap fills or other drainage or stabilization features with potential ground disturbance outside the established roadway (toe of fill to top of cut); realignment; and widening of curves as needed for passage of log trucks, chip vans, and other critical vehicles. Reconstruction also includes the actions included in the Maintenance category. Reconstruction also includes the replacement of unsustainable existing roads with new, designed roads.

It is estimated that a majority of lower standard system roads (operational maintenance levels 1-2) used for treatment access and forest product removal would receive reconstruction. Arterial and collector roads accessing vegetation treatments would be prioritized for reconstruction.

Road Construction - Designed Roads

During treatment implementation, an engineering analysis and determination would be made for each road as to whether the route is needed for long-term access (as a National Forest System road - only designed roads would be candidates) or only for temporary project treatment use.

Where access is needed and adjacent resource concerns exist (perennial and intermittent stream crossings, high soil erosion hazard, steeper side slopes, etc.), designed roads can be used – located, designed to engineering standards, and constructed with a higher level of control by the Forest Service engineering department. Actions for designed roads include vegetation clearing, excavation and embankment, blading and shaping, installation of drainage structures, and importing of armoring and surfacing rock material as needed. Designed or specified ("spec") roads would be used where adjacent resource concerns exist (perennial and intermittent stream crossings, high soil erosion hazard, steeper side slopes, etc.). When an existing system road is having an unacceptable resource impact (e.g. located within an active floodplain), the road may be re-located to a less impactful location. In such cases, the new designed road would be retained as it is part of the Forest transportation system.

For purposes of analysis, it is assumed that at least 80% of designed roads constructed would be decommissioned post-project implementation, including any associated reforestation, slash disposal activities, etc. However, the GMUG anticipates decommissioning all designed roads. All temporary roads constructed would be decommissioned post-project implementation.

Decommissioning involves removing bridges and culverts, eliminating ditches, out-sloping the roadbed, contouring to re-establish the natural undisturbed slope, scarifying of the road surface to reduce compaction, removing ruts and berms, effectively blocking the road to normal vehicular traffic where feasible under existing terrain conditions, and building cross ditches and water bars. When bridges and culverts are removed, associated fills shall also be removed to the extent necessary to permit normal maximum flow of water and reconstruction of the floodplain and stream channel as needed. Seeding is also a Forest standard for rehabilitation of disturbed areas.

Road Construction – Temporary Roads

Temporary roads are existing routes which would be used for this project and then decommissioned or newly constructed roads for this project to be decommissioned after use. Temporary roads could be used for short-term treatment access where minimal resource concerns exist; these roads are located by agreement between the contractor and the Forest Service and have basic standards (per timber sale contract, BMPs, and design features).

Construction of new temporary roads would include vegetation clearing, excavation, blading and shaping. Existing temporary roads would be reconstructed as necessary to provide for safe project access and removal of forest products. New and existing temporary roads would also have improvements necessary to attain stabilization of the roadbed and fill slopes, including employing measures such as out-sloping, drainage dips, and water-spreading ditches. Unlike permanent roads, temporary roads would only have the minimal investment and drainage required to minimize resource impacts while providing for safe use and passage of haul vehicles during the short life of the route.

After a temporary road has served the project purpose, the Forest Service will coordinate decommissioning, with the same activities described for decommissioning designed roads. The Forest Service would be responsible for decommissioning temporary roads that remain open for post-contract activities such as pile burning. Temporary roads shall be decommissioned in a timely fashion following implementation of project vegetation treatments.

Stored Roads

There are operational maintenance level 1 roads (currently closed and stored) that are listed for reconstruction or maintenance treatments. By definition, these roads are expected to be used intermittently when needed for treatment activity access, but kept closed for periods of years between uses. When assigned under the action alternatives, these routes would be opened and receive the appropriate maintenance or reconstruction treatment as described above. In addition, these roads would remain in the Forest transportation system but would be physically closed to all motor vehicle travel following the treatment activity.

Closure would be implemented by using physical, native material barriers. Beyond the closure, the integrity of ML1 roads would be preserved to the extent practicable, implementing measures as necessary to reduce sediment delivery from the road surface and fills and reduce the risk of crossing failure and stream diversion – making it hydrologically neutral. An example of this would be removal of culverts.

While closed to all motor vehicle traffic, system roads are categorized as being in Maintenance Level 1.

Roads closed to public motor vehicle use, but which receive Forest Service administrative traffic, are constant service roads and are thus not level 1.

Right-of-way Acquisition

Some roads under private jurisdiction may provide more efficient access to the project and/or minimize need for new ground-disturbing roadwork. These roads would require a Forest Service

right-of-way or access agreement to allow for access and haul of forest products. Where appropriate, public easements would be pursued, at a minimum administrative access would be needed for project use. If the Forest Service were to pursue such rights-of-way or access agreements, such would be accomplished via separate NEPA processes.

Use and Encroachment of Other Public Roads

Public roads not managed by the Forest Service, including county and State managed roads, will be needed in order to access vegetation treatments. In addition, treatments would occur along and adjacent to public roads managed by other jurisdictions. Use of existing National Forest System access roads and intersections that connect to these public routes is preferred. Where SBEADMR implementation efforts could potentially interfere with traffic or operations of these public roads, coordination with the applicable agency is necessary. This includes construction of new intersections and access aprons that would tie into existing public roads. Coordination should address signing and traffic control, permitting, alignment, and construction standards necessary for new aprons and intersections, at a minimum.

Other Infrastructure

Available water and rock material sources within and adjacent to the project area would be utilized to support project road work. Roads providing access to and from these sites would also be maintained, and reconstructed when applicable. Water will generally come from sources off-Forest as supplied by the contractor. Existing and future[5] sources on NFS lands, including Los Pinos, Sage Park, Burro Park; and Mill Creek rock pits, would likely be utilized. Existing Forest Service pits would be used where economically feasible, otherwise rock would come from commercial sources off-forest.

Effects Common to All Action Alternatives

The following effects are anticipated to occur. Use of SBEADMR design features will minimize adverse effects related to the transportation system.

Temporary Road Closures for Worker and Public Safety

During road work activities as well as implementation of the proposed project vegetation treatments, temporary road closures would be utilized to provide for public and worker safety, as well as more efficient traffic flow. Use of transportation System and Haul Route (TSHR) design feature TSHR-5 would minimize adverse effects to safety from traffic.

[5] Any new quarries would be planned, managed and implemented under a separate NEPA process.

Dust

It is anticipated that road work and use of roads to implement the proposed vegetation treatments would temporarily increase dust and airborne particulate matter emissions. Use of transportation System and Haul Route (TSHR) design feature TSHR-7 would minimize adverse effects due to dust.

Vegetation Clearing

Work on existing roads would remove and reduce vegetation interfering with the operation of the existing roadways. In addition, temporary and designed road construction would result in vegetation clearing to accommodate a single-lane road template. These activities are generally beneficial with regards to managing the roadway for vehicle passage and sight distance. Skid trails which will connect to transportation system will also result in vegetation removal.

Soil Compaction

Work on existing roads would minimally increase soil compaction, intentionally to ensure the roadway is prepared to safely and efficiently accommodate users including log trucks. Temporary and designed roads would intentionally have soils compacted to provide a functional roadway for project implementation. Temporary roads and select designed roads would be decommissioned, reducing the compaction; however, permanent designed roads would have more permanent soil compaction to preserve the integrity of the facility for long-term use. Maintenance activities not specified as part of treatment such as hazard tree removal adjacent to roadways may also increase soil compaction. Skid trails which will connect to transportation system would also result in soil compaction.

Traffic

During treatment implementation, traffic would increase due to movement of equipment, forest products, and personnel in and out of the project area. Main collector and arterial forest roads would receive the majority of traffic. All haul routes would have surface deterioration proportionate to the traffic volume. Surface rock replacement funds would be collected and applied accordingly. Design features would be employed to avoid unacceptable rutting of the surface and deformation of the subgrade.

Access

Following implementation, the combination of road maintenance to existing roads, improvements to the existing roads, and removal of roadside hazards would provide for improved short-term public and administrative access throughout the treated area; such improvements may persist after the duration of the SBEADMR implementation timeframe. If

new designed roads are retained for administrative access after post-treatment activities, this would provide improved long-term administrative access. In addition, the roadwork applied during implementation would leave the system in a more stable and functional condition, minimizing adverse resource impacts including erosion and sedimentation.

No long-term changes to public motor vehicle use are proposed under any alternative; previously designated routes documented on the motor vehicle use maps (MVUM) would remain open following project implementation.

Winter logging would likely occur, and snow plowing in accordance with design features would allow for safe project access, product haul, and resource protection.

In summary, the action alternatives may have positive effects on the Forest transportation system. Benefits include: rerouting unsustainable existing roads, bringing the maintenance level closer to the desired condition on roads used for treatments, improving roads used for project treatments through maintenance or reconstruction to minimize adverse resource impacts to other resources, and sustaining safe public and administrative access throughout the project area.

Design Features

The following Transportation System and Haul Routes (TSHR) treatment design features apply to roads under all action alternatives (

Table 19). Use of the design features for all action alternatives is assumed in this effects analysis.

Sufficient design features are applied such that the action alternatives are consistent and compliant with applicable transportation direction.

There are several other design features that apply to roads to help mitigate effects to other resources; those features are documented and discussed in the associated resource sections and in Appendix B.

Table 19. Transportation System Design Features

Design Feature	Trigger for use	Description	Effect
TSHR-1	All mechanical treatments	Existing roads will be used for equipment access to the extent road location and condition permit reasonable access. Existing roads will be restored to the appropriate condition prior to use. Priority must be given to maintenance and reconstruction of the existing transportation system to ensure and continue its integrity.	Minimize impacts to NFS lands by using existing roads.
TSHR-2	New road construction	New Access Roads: Where terrain, road length, and other resource risks exist, a "Designed Road" shall be utilized for Project access. Designed Roads would be surveyed, designed, and administered by the Forest Service engineering department. Designed Roads may become National Forest System roads if needed for long-term access and utilization, or may be subsequently decommissioned if only needed for temporary project access. The District Ranger shall be responsible for determining whether a designed road is to be added to the Forest transportation system. Temporary roads may be used where a designed road is not needed, as determined by the Forest Service. The location and clearing widths of all Temporary Roads or facilities shall be agreed to in writing (between the Forest Service and the contractor) before construction is started. Following use for harvest and project implementation, temporary roads will be decommissioned, which involves recontouring where significant sideslope exists, elimination of ditches and other structures, outsloping the roadbed, removal of ruts and berms, effectively blocking the road to normal vehicular traffic where feasible, and construction of drainage features such as cross ditches and water bars. Invasive species monitoring will occur after road decommissioning and will be followed by weed treatments where needed.	Improved access to vegetation treatments in appropriate locations.
TSHR-3	All commercial treatments	Require commercial haulers to perform maintenance commensurate with their use; depositing sufficient funds with the Forest Service may be used in lieu of performance. Surface rock replacement deposits will be collected to maintain currently surfaced roads that are used for timber hauling. Deposits will be collected commensurate with the use. Quarry materials will be collected from a site that has been found to be free of invasive plants and would meet quality and gradation requirements.	Protection of existing infrastructure.
TSHR-4	Wet conditions	Timber hauling operations will be restricted during wet or thawed conditions, when needed to protect the road surface. Professional judgment is required to assess whether a full highway legal load (85,000 lbs.) can reasonably manage the conditions without causing	Avoiding unacceptable rutting of the surface and deformation of the subgrade.

Design Feature	Trigger for use	Description	Effect
		damage.	
TSHR-5	All operations	Safety signing will be used to alert the public that logging operations are in progress and shall meet the requirements of the Manual of Uniform Traffic Control Devices (MUTCD). If use or locations justify, active traffic control would be utilized.	Compliance with requirements on public roads; safer work sites for workers, administration, and public traffic.
TSHR-7	All operations	Use suitable road surface stabilization practices and dust abatement supplements on roads with high or heavy traffic use (See FSH 7709.56 and FSH 7709.59).	Protection of existing infrastructure. Better visibility and safer use of project roads.
TSHR-8	Snowy conditions	Move snow in a manner that will avoid or minimize disturbance of or damage to road surfaces and drainage structures. Use existing standard contract language (C5.316# or similar) for snow removal during winter logging operations to avoid, minimize, or mitigate adverse effects to soil, water quality, and riparian resources. Where heavy winter recreational use occurs and conditions allow, utilize bypass routes to separate recreational and project-related traffic.	Protection of road surfaces and mitigation of adverse effects to natural resources. Safer use for public and worker and administrative traffic.

Alternative 2 (Proposed Action) – Direct and Indirect Effects

Approximately 4,000-6,000 acres of commercial harvest treatments of aspen, spruce and aspen/spruce mix would likely occur annually or a total 40,000-60,000 acres over the ten year span of the project. In order to access proposed treatments and remove forest products, Alternative 2 includes the following maximum estimated roadwork. This is based on an anticipated Forest capability to commercially treat up to 60,000 acres over the life of the project. This roadwork is in accordance with the detailed descriptions for each activity as provided above.

Table 20. Maximum Potential Alternative 2 Road Treatments

Roadwork Activity	Miles
Designed Road Construction	60
Designed Road Decommissioning[1]	(48)
Temporary Road Construction	260
Temporary Road Decommissioning[2]	(260)
Road Reconstruction	260
Maximum Additional Roads in long-term[1]	**12**
Road Maintenance	
Operational Maintenance Level 5	4
Operational Maintenance Level 4	120
Operational Maintenance Level 3	230
Operational Maintenance Level 2	80
Operational Maintenance Level 1	10
Total Maintenance Miles[3]	**444**

[1] For purposes of analysis, the assumption is that 80% of designed roads constructed in SBEAMDR would be decommissioned. The GMUG anticipates decommissioning most, if not all, designed roads constructed roads for this project.
[2] 100% of temporary roads constructed in SBEAMDR would be decommissioned
[3]Some of the identified maintenance may overlap with the miles of reconstruction and construction needs identified in

Table 9. Other maintenance would occur on additional, currently existing roads.

Alternative 3 (Public Safety) – Direct Effects

Alternative 3 shifts the geographic extend of treatments such that treatments would be limited to the targeted vegetation types within the WUI and to road corridors and additional identified infrastructure extending beyond the WUI. In order to access proposed treatments and remove forest products, Alternative 3 includes the following estimated roadwork. This is based on an anticipated Forest capability to commercially treat up to 60,000 acres over the life of the project. This roadwork is in accordance with the detailed descriptions for each activity as provided above.

Table 21. Maximum Potential Alternative 3 Road Treatments

Roadwork Activity	Miles
Designed Road Construction	10
Designed Road Decommissioning[1]	(8)

Roadwork Activity	Miles
Temporary Road Construction	70
Temporary Road Decommissioning[2]	(70)
Road Reconstruction	260
Maximum Additional Roads in long-term[1]	**2**
Road Maintenance	
Operational Maintenance Level 5	6
Operational Maintenance Level 4	180
Operational Maintenance Level 3	350
Operational Maintenance Level 2	90
Operational Maintenance Level 1	10
Total Maintenance Miles[3]	**976**

[1] For purposes of analysis, the assumption is that 80% of designed roads constructed in SBEAMDR would be decommissioned. The GMUG anticipates decommissioning most, if not all, designed roads constructed roads for this project.
[2] 100% of temporary roads constructed in SBEAMDR would be decommissioned
[3]Some of the identified maintenance may overlap with the miles of reconstruction and construction needs identified in

Table 9. Other maintenance would occur on additional, currently existing roads.

Alternative 4 (Spruce-fir Salvage Only) – Direct and Indirect Effects

Alternative 4 limits spruce treatments to salvage only; aspen treatments would be the same as in Alternative 2. In order to access proposed treatments and remove forest products, Alternative 4 includes the following estimated roadwork. This is based on an anticipated Forest capability to commercially treat up to 60,000 acres over the life of the project. This roadwork is in accordance with the detailed descriptions for each activity as provided above.

Table 22. Maximum Potential Alternative 4 Road Treatments

Roadwork Activity	Miles
Designed Road Construction	60
Designed Road Decommissioning[1]	(48)
Temporary Road Construction	260
Temporary Road Decommissioning[2]	(260)
Road Reconstruction	260
Maximum Additional Roads in long-term[1]	**12**
Road Maintenance	
Operational Maintenance Level 5	4

Roadwork Activity	Miles
Operational Maintenance Level 4	120
Operational Maintenance Level 3	230
Operational Maintenance Level 2	80
Operational Maintenance Level 1	10
Total Maintenance Miles[3]	**444**

[1] For purposes of analysis, the assumption is that 80% of designed roads constructed in SBEAMDR would be decommissioned. The GMUG anticipates decommissioning most, if not all, designed roads constructed roads for this project.
[2] 100% of temporary roads constructed in SBEAMDR would be decommissioned
[3]Some of the identified maintenance may overlap with the miles of reconstruction and construction needs identified in

Table 9. Other maintenance would occur on additional, currently existing roads.

Comparison of Alternatives

Table 23 compares miles of maximum potential road work (construction, decommissioning and maintenance) among the action alternatives. Under Alternatives 2 and 4, the amounts are identical. Alternative 3 has the least amount of designed road construction (10 miles) and the highest amount of road maintenance (640 miles). Under Alternatives 2 and 4, a maximum of approximately 60 miles of designed road construction may occur, and a maximum of 440 miles of road maintenance may occur. The greatest disparity is among temporary roads. Under Alternative 3, a maximum of 70 miles of temporary roads may be constructed, as compared to a maximum potential for 260 miles under Alternatives 2 and 4. All temporary roads would be decommissioned after vegetation treatments are complete, and at least 80% of designed roads would be decommissioned.

Table 23. Comparison of Alternatives

ROAD WORK CATEGORY	Alt1	Alt2	Alt3	Alt4
Designed Road Construction- Miles	**0**	60	10	60
Designed Road Decommissioning (Post-vegetation treatment) – Miles	**0**	48	8	48
Temporary Road Construction – Miles	**0**	260	70	260
Temporary Road Decommissioning (Post-vegetation treatment) – Miles	**0**	260	70	260
Road Reconstruction – Miles	**0**	260	260	260

ROAD WORK CATEGORY	Alt1	Alt2	Alt3	Alt4
Road Maintenance – Miles	**0**	440	640	440

Cumulative Effects Common to All Action Alternatives

Cumulative effects common to all action alternatives are similar to cumulative effects under the No Action Alternative, with minor differences. Relative to the No Action Alternative, more roads would be maintained under all action alternatives. A short-term reduction in public access would occur in order to minimize user conflicts during individual treatment implementation. Following implementation of the action alternatives and other projects involving road maintenance, a better maintained road system would exist. The maintenance would provide improved short and medium-term public and administrative access throughout the GMUG. If potential designed roads associated with SBEADMR are retained, though most would be decommissioned following SBEAMDR implementation, those retentions would result in small long-term improvement for administrative access throughout the GMUG. Public access would not be affected, as such roads would not be open to the public.

Air Quality

Compliance with Regulatory Direction

Federal Laws and Regulations

Under the Clean Air Act (CAA) the Environmental Protection Agency (EPA) sets limits on certain air pollutants and establishes a regulatory framework for states to follow to protect air quality. Federal land management agencies must comply with the National Ambient Air Quality Standards (NAQQS) and Prevention of Significant Deterioration (PSD), and Air Quality Related Values (AQRVs). AQRV's are a scenic, cultural, physical, biological, ecological, or recreational resource on federal lands which may be affected by a change in air quality as defined by the Federal Land Manager (FLM). The Forest Service and other federal agencies have established air quality monitoring programs to study the condition of AQRVs in Class I and Class II air quality areas.

National Ambient Air Quality Standards (NAAQS)

The Clean Air Act identifies two types of national ambient air quality standards. Primary standards provide public health protection, including protecting the health of sensitive populations such as asthmatics, children, and the elderly. Secondary standards provide public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings (Environmental Protection Agency 2011).

The Prevention of Significant Deterioration (PSD) Program is a Clean Air Act requirement that sets emission limitations for major new or modified sources of air pollution such as coal fired electrical power generation plants, and sets limits to an increase of pollutants in Class I and Class II areas.

EPA has set NAAQS for six principal pollutants, which are called "criteria" pollutants. These include carbon monoxide, lead, nitrogen dioxide, ozone, particle pollution, and sulfur dioxide (Environmental Protection Agency 2011).

Regional Haze Rule

Regional haze is a term used to describe the white or brown haze that obstructs vistas. It is caused by fine particles in the air including sulfates, carbon, soils and nitrates. Air pollutants contributing to regional haze can be both locally derived and carried into an area by the wind hundreds and even thousands of miles from a pollutant source. More than half the regional haze in Colorado comes from sources outside of the state (CDPHE 2012).

The Regional Haze Rule calls for state and federal agencies to work together to improve visibility in impaired mandatory Class I areas. Mandatory Class I areas include National Parks and Wilderness areas that were congressionally designated under the Clean Air Act for stringent protection of their pristine air quality (40 CFR PART 81), Areas not designated as Class I are Class II. In January, 2011, the Colorado Air Quality Control Commission approved the State's Regional Haze State Implementation Plan which sets a Reasonable Progress Goal for each Class I area to protect the best days and to improve visibility on the worst days during the time period between 2007-2018 (CDPHE 2011).

Three Wilderness areas within NFS lands on the GMUG (West Elk Wilderness, La Garita Wilderness, and the Maroon Bells-Snowmass Wilderness) are all managed as Class I airsheds with the highest standards for air quality. The Black Canyon of the Gunnison National Park adjacent to the GMUG near Montrose, Colorado, is also managed as a Class I airshed. The remaining airsheds of the GMUG are managed as Class II areas.

In the Maroon Bells-Snowmass, La Garita, and West Elk Wilderness areas, regional haze has reduced visibility by 3.07 deciviews from natural conditions (i.e. without human caused air pollution) during the analysis period from 2000 to 2004 (CDPHE 2007).

While federal land managers are tasked under the Clean Air Act with the affirmative responsibility to protect the AQRVs, including visibility of these Class I areas, the permitting authority lies with the State of Colorado and EPA.

State Laws and Regulations

The Colorado Department of Public Health and Environment, Air Pollution Control Division (CDPHE), oversees the development and adoption of the State's air quality regulation program. The commission can set its own Ambient Air Quality Standards that are equally or more stringent than the Federal air quality standards. The CDPHE implements the air management programs adopted by the commission and enforces compliance with the NAAQS, PSD increments, and regulates smoke emissions from prescribed burning in accordance with Colorado State Regulation 9 (Open Burning, Prescribed Fire, and Permitting – CDPHE 2015).

Fire managers will coordinate with the State and follow rules to protect air resources including obtaining and following prescribed burning smoke permits. The permit application contains estimates of smoke production, mitigation measures, and notification processes. If necessary, smoke monitors will be used for public safety.

In order to protect human health and safety, fire managers are required to burn only when authorized by the CDPHE and must meet numerous smoke permit requirements including notification of the public and CDPHE, ignition timing, ventilation objectives, transport winds, smoke contingency planning and implementation of best management practices.

Colorado incorporated the EPA's Tailoring Rule revisions into Air Quality Control Commission (CDPHE) Regulation No. 3 on October 21, 2010. Effective January 2, 2011, GHG became subject to regulation for prevention of significant deterioration (PSD) from stationary sources. Beginning July 1, 2011, any stationary source with the potential to emit greater than 100,000 tons per year (tpy) CO2e may be required to obtain a Title V operating permit and/or a PSD preconstruction permit. Prescribed burning is not considered a stationary source and is exempt from the rule.

Forest Service Direction

Forest Service direction guiding this project includes Forest Service Manual 2500, (Watershed and Air Management, Chapter 2580 - Air Resource Management), The Forest and Rangeland Renewable Resource Planning Act of 1974, and The GMUG Land and Resource Management Plan (Forest Plan). The Forest and Rangeland Renewable Resource Planning Act, as amended by the National Forest Management Act (16 U.S.C. 1602), directs the Secretary of Agriculture to protect and, where appropriate, improve the quality of soil, water, and air resources. In addition, the Clean Air Act, as amended (42 U.S.C. 7401 et seq.), significantly broadened the authority and responsibility of the Forest Service. The objectives of air resource management are:

1. Protect air quality related values within class I areas, as described in 42 U.S.C. 7475(d)(2)(B) and (C) and section 2580.5.
2. Control and minimize air pollutant impacts from land management activities.

3. Cooperate with air regulatory authorities to prevent significant adverse effects of air pollutants and atmospheric deposition on forest and rangelands.

The 2007 GMUG Land and Resource Management Plan Forest Plan Amendment (LRMP 2007) establishes policy regarding fire and fuels management, the use of natural fires to meet resource management objectives, air quality and the prevention of significant deterioration. Management goals focus on the protection of pristine air quality in congressionally designated Class I Wilderness areas. The Plan's Standards and Guidelines also address Class I air quality protection as well as compliance with state and federal air quality standards (LRMP 2007).

Smoke production and air quality issues centers around four different aspects (LRMP 2007):

- First is the degradation of visibility on the Grand Mesa, Uncompahgre and Gunnison National Forest with additional areas most likely to be affected by smoke as the I-70 Interstate corridor; the North Fork, Uncompahgre and the Gunnison River Valleys; and the towns of Grand Junction, Delta, Cedaredge, Paonia, Hotchkiss, Olathe, Montrose, Ridgeway, Ouray, Telluride, Norwood, Nucla, Naturita, Paradox, Gunnison and Crested Butte.
- Second, portions of the public become irritated with smelling smoke, seeing smoke, breathing smoke over long periods of time, and having smoke in their homes.
- Third, there is a segment of the public that has respiratory problems that are aggravated by irritants in wood smoke.
- Fourth, public safety along travel corridors.

Analysis Methodology

For this analysis, the air quality issues of concern entail compliance with the Clean Air Act, the State of Colorado air quality standards and regulations, and the Wilderness Act. Air quality standards primarily address human health. Under the Clean Air Act, federal land managers have a responsibility to protect Class I air quality related values (AQRVs) from degradation. The Wilderness Act requires that congressionally designated wilderness areas be managed for their protection and preservation from human caused degradation. A review of pertinent sections of the Clean Air Act and State of Colorado air quality management regulations is presented above, in order to frame the extent of the analysis and point out essential compliance requirements.

Indicators used in this analysis include the following:

- Compliance with NAAQS and the Prevention of Significant Deterioration (PSD) Program
- Potential impacts to AQRVs which includes visibility impacts to Class I Wilderness areas, sensitive Class II wilderness areas, and important Scenic Vistas

- Potential impact of prescribed burning to particulates
- Potential impact of prescribed burning to Greenhouse Gases (GHGs)

Assumptions

To approximate a range of emissions the proposed SBEADMR project would produce, the following assumptions were made:

- Based on the proposed action and for the purposes of this analysis, we assume treatments would occur over ten years.

- We assume one-half of all treatments would occur in the Gunnison Basin and one-half would occur outside the Gunnison Basin on the Grand Mesa and Uncompahgre Plateau, and that ninety percent of commercial recovery and resiliency treatments would occur in spruce and ten percent in aspen.

These assumptions are broad and are the best estimate available at the time of this analysis. However they allow emissions estimates that cover the duration of all SBEADMR treatments. The emissions estimate ranges presented here are maximum amounts.

There are currently several other vegetation management projects in the implementation stage on the Forest that also produce smoke emissions. There are five other vegetation and fuels management projects and three coal, oil and gas lease revision or modification projects in the planning stage. These other current and planned projects do not have smoke emissions estimates available for use in this analysis. Also, the amounts of potential smoke emissions from managed wildfire over the lifetime of the SBEADMR implementation period is unknown.

Modeling

To estimate emissions from prescribed burning, two models are used. Both the Piled Fuels Biomass and Emissions Calculator (PFBME), and First Order Fire Effects Model (FOFEM) estimate NAAQS criteria pollutants and GHG emissions. The online Piled Fuels Biomass and Emissions Calculator are used to estimate prescribed burning emissions from slash piles (USDA Forest Service 2014b). The computer-based program FOFEM version 6 is used to estimate prescribed burning emissions in aspen.

Emissions outputs available from the Piled Fuels Biomass and Emissions Calculator (PFBEC) and FOFEM do not entirely overlap: FOFEM can calculate NOx while PFBEC cannot, and PFBEC can calculate particulate matter and nonmethane hydrocarbons (NMHC) while FOFEM cannot.

The SBEADMR DEIS is landscape in scale and adaptive in scope. Therefore, modeling for smoke dispersion effects using models such as CALPUFF is not feasible and would not be meaningful since the exact location, project size, fuel loads and burning reductions, and timing (relating to fuel moisture and weather conditions) of individual prescribed burns cannot be predicted at the time of this writing. Smoke dispersion modeling is not required by the State of Colorado for prescribed burning permitting; however, emissions estimates are required (CDPHE 9, V. Planned Ignition Fire Permits, D. 7.).

The U.S. EPA's Motor Vehicle Emissions Simulator (MOVES) are used for generating equipment emissions factors (Environmental Protection Agency 2014b). Equipment use estimates are used to calculate logging equipment emissions. The MOVES model estimates vehicle emissions decreasing over time as newer and more efficient vehicles are produced. For this analysis, emissions factors for 2015 vehicles are used.

Climate Change – Greenhouse Gasses and Carbon Sequestration

Currently there are no national or state legal requirements concerning the analysis of or compliance with any GHG emissions or sequestration regulations for projects such as SBEADMR. On 16 January 2009, the Washington Office of the USDA Forest Service released guidance to Forest Service units regarding the incorporation of climate change science into project level EPA documents (Climate Change Considerations in Project Level NEPA Analysis, January 13, 2009 - USDA 2009).

This guidance document provides that units should consider two kinds of climate change effects at the project level. First, units may, where appropriate, consider the effect of a project on climate change. Second, units may, where appropriate, consider the effect of climate change on a proposal. (See, Harper v. Tidwell, U.S. District Court for the District of Montana, October 30, 2008.) The effects of climate change to GMUG forest ecosystems are described in detail in Chapter 1. This air quality analysis discloses a range of potential NAAQS criteria pollutants and GHG emissions the SBEADMR project could produce and compares those amounts to relevant emissions inventories at state and national levels.

On December 18, 2014, CEQ released revised draft guidance for public comment that describes how Federal departments and agencies should consider the effects of greenhouse gas emissions and climate change in their NEPA reviews. The revised draft guidance supersedes the draft greenhouse gas and climate change guidance released by CEQ in February 2010. This guidance explains that agencies should consider both the potential effects of a proposed action on climate change, as indicated by its estimated greenhouse gas emissions, and the implications of climate change for the environmental effects of a proposed action. The guidance also emphasizes that agency analyses should be commensurate with projected greenhouse gas emissions and climate impacts, and should employ appropriate quantitative or qualitative analytical methods to ensure

useful information is available to inform the public and the decision-making process in distinguishing between alternatives and mitigations. It recommends that agencies consider 25,000 metric tons of carbon dioxide equivalent emissions on an annual basis as a reference point below which a quantitative analysis of greenhouse gas is not recommended unless it is easily accomplished based on available tools and data. Unlike the 2010 draft guidance, the revised draft guidance applies to all proposed Federal agency actions, including land and resource management actions. It reflects CEQ's consideration of comments received on the 2010 draft guidance in addition to other Federal agency and affected stakeholder input. It does not create new or additional regulatory requirements. It instructs agencies on how to address the greenhouse gas emissions from and the effects of climate change on their proposed actions within the existing NEPA regulatory framework. CEQ extended the public comment period on the revised draft guidance for an additional 30 days, with the comment period now closing on March 25, 2015.

Affected Environment

Air Quality Monitoring

Colorado has been divided into eight multi-county planning areas that are generally based on topography and have similar airshed characteristics. The planning area considered in this analysis falls within three of Colorado's air quality planning regions: 1) The Central Mountains Region includes Gunnison and Hinsdale Counties; 2) the San Luis Valley Region includes Saguache County; 3) the Western Slope Region includes Garfield, Mesa, Delta, Montrose, Ouray and San Miguel Counties (CAQDR 2012).

The Central Mountains Region consists of 15 counties in the central area of the state. The Continental Divide passes through much of this region. Mountains and mountain valleys are the dominant landscape. Leadville, Steamboat Springs, Cañon City, Salida, Buena Vista, Aspen, Gunnison and Crested Butte represent the larger communities. The population of this region is about 256,800, according to U.S. Census Bureau estimates. Skiing, tourism, ranching, mining, and correctional facilities are the primary industries. Black Canyon of the Gunnison National Park is located in this region. All of the area meets with National Ambient Air Quality Standards (CAQDR 2012).

Colorado's San Luis Valley Region is in the south central portion of Colorado and includes a broad alpine valley situated between the Sangre de Cristo Mountains on the northeast and the San Juan Mountains of the Continental Divide to the west. The valley is some 71 miles wide and 122 miles long, extending south into New Mexico. The average elevation is 7,500 feet. Principal towns include Alamosa, Monte Vista, and Del Norte. The population is about 45,100 according to U.S. Census Bureau estimates. Agriculture and tourism are the primary industries. The valley

is semiarid and croplands of potatoes, head lettuce, and barley are typically irrigated. The valley is home to Great Sand Dunes National Park (CAQDR 2012).

The Western Slope Region includes nine counties on the far western border of Colorado. A mix of mountains on the east, and mesas, plateaus, valleys and canyons to the west form the landscape of this region. Grand Junction is the largest urban area, and other cities include Telluride, Montrose, Delta, Rifle, Glenwood Springs, Meeker, Rangely, Craig, Paonia, Cederedge, Ridgeway and Ouray. The population of this region is about 309,700, according to U.S. Census Bureau estimates. Primary industries include ranching, agriculture, mining, energy development and tourism. Dinosaur and Colorado National Monuments are located in this region (CAQDR 2012).

The Western Slope, along with the central mountains, is projected to be the fastest growing area of Colorado through 2020 with greater than two percent annual population increases, according to the Colorado Department of Local Affairs.

All of these areas comply with National Ambient Air Quality Standards (CAQDR 2012).

Currently there are no exceedances of the NAAQS in the vicinity of the project area. Air quality is affected by activities both on the GMUG and emissions from other activities and areas in both the Rocky Mountain and Colorado Plateau region. Air quality is affected by: smoke from both wildfire and prescribed burns; wind events; dust from road construction, maintenance and use; emissions from vehicle and equipment use; agricultural activities; and methane venting from coal mining on the GMUG. None of these emissions have reached levels that have demonstrated non-attainment conditions on the GMUG (LRMP 2007).

Methane is a recognized GHG but is not a pollutant under the EPA air quality standards. There has been an increased need to vent methane from coal mines in the North Fork Valley. Since 2001, there have been numerous venting wells drilled in the area and one coal mine near Somerset, Colorado vents an estimated 4.9 to 6.9 billion cubic feet of methane gas per year, which represents about 0.03 percent of the total United States GHG (2002). There is no indication that venting of methane for mine safety reasons will be reduced in the near future through capture or energy production (LRMP 2007).

Acid Deposition Monitoring

Elevated emissions of sulfur dioxides and nitrogen oxides can react with water molecules in the atmosphere, resulting in acidic precipitation. This precipitation is harmful to native plant communities, aquatic life, soil productivity, and cultural sites such as historic and prehistoric rock art. Monitoring of nitrogen dioxide deposition in alpine areas is occurring in the San Juan Mountains (Waterfall Canyon, near Telluride) and some lake water chemistry monitoring has

occurred within the West Elks and Raggeds Wilderness Areas to determine if there is pollutant deposition. Evaluation of monitoring data for these high elevation areas has not indicated any recognizable trends associated with air quality (USDA Forest Service 2006d). The GMUG conducts long-term lake monitoring as part of the air quality program at two locations on the forest, Deep Creek Lake Monitoring Site, and South Golden Lake Monitoring Site. On the White River National Forest adjacent to the GMUG on the north, acid deposition is monitored through the following programs:

- Wilderness lake monitoring program
- U.S. Geological Survey's (USGS) snow chemistry monitoring program
- National Acid Deposition Program (NADP)

The USGS monitoring effort shows increasing trends in the concentrations and deposition of ammonium (NH_4) and nitrate (NO_3) and decreasing trends in sulfate (SO_4). The increases in NH_4 and NO_3 are likely due to increased emission sources from the region's growth in both population and energy development (Ingersol et al 2007; USDA Forest Service 2014c, White River National Forest Oil and Gas Lease Forest Plan Amendment EIS).

Climate Change – Greenhouse Gases and Carbon Sequestration

Greenhouse Gases

Three of the most important greenhouse gases (GHG) resulting from human activity are carbon dioxide (CO2), methane (CH4) and nitrous oxide (N2O). They are produced by both natural processes and human activity. While they make up less than one percent of the Earth's atmosphere, they exert a powerful influence over global temperatures.

Greenhouse gases play a role in the natural environment by absorbing the sun's heat. As the sun's energy radiates back from the Earth's surface toward space, these gases trap the heat in the atmosphere, keeping the planet's surface warmer than it would otherwise be. Increases of atmospheric greenhouse gases result in additional warming of the Earth's atmosphere. Carbon dioxide equivalents (CO2e) is a metric used to compare the emissions from various greenhouse gases based upon their global warming potential (GWP). For instance, over a 100 year period the GWP of methane (CH4) is estimated to be about 21 times greater than carbon dioxide (CO2), so its carbon dioxide equivalent (CO2e) is 21. The carbon dioxide equivalent (CO2e) of nitrous oxide (N2O) is 310 (Environmental Protection Agency 2005).

The estimated amount of GHG emissions that will be produced in Colorado in 2020 is 147.5 million metric tons (Center for Climate Strategies 2007). The estimated amount of GHG emissions produced in the United States in 2012 was 6,525.6 million metric tons (Environmental Protection Agency 2014a).

In 2005, Colorado's greenhouse emissions were 35 percent higher than they were in 1990. They are projected to grow 81 percent above the 1990 levels by 2020 (CDPHE 2010a). Climate change related impacts observed in Colorado in recent decades include shorter and warmer winters with reduced snowpack and earlier spring runoff, more precipitation falling as rain rather than snow, and longer periods of drought (CDPHE 2010a).

Carbon Sequestration

Forested lands across the United States currently serve as a carbon 'sink', offsetting approximately 15% of U.S. emissions from burning fossil fuels in 2012, and from 10 to 20% of U.S. emissions each year. Climate change may affect the ability of forests to continue to store and sequester carbon. Climate change increases the uncertainty of U.S. forests' ability to serve as a "sink" for carbon storage, but management options exist that could buffer the impacts of climate change on forests, and even lead to increased forest carbon storage potential. Trees take up carbon dioxide (CO2) and release oxygen (O2) through photosynthesis, transferring the carbon (C) to their trunks, limbs, roots, and leaves as they grow. When leaves or branches fall and decompose, or trees die, the stored C will be released by respiration and/or combustion back to the atmosphere or transferred to the soil. Because of these processes, forests and forested landscapes can store considerable carbon and their growth can provide a carbon sink; landscapes that have been recently converted or reconverted to forests (from another land cover) can provide a carbon sink that is considerably larger than other land cover types (Ryan, et. al. 2012). Figure 18 displays the major forest carbon pools in the conterminous U.S. from 2000 to 2009.

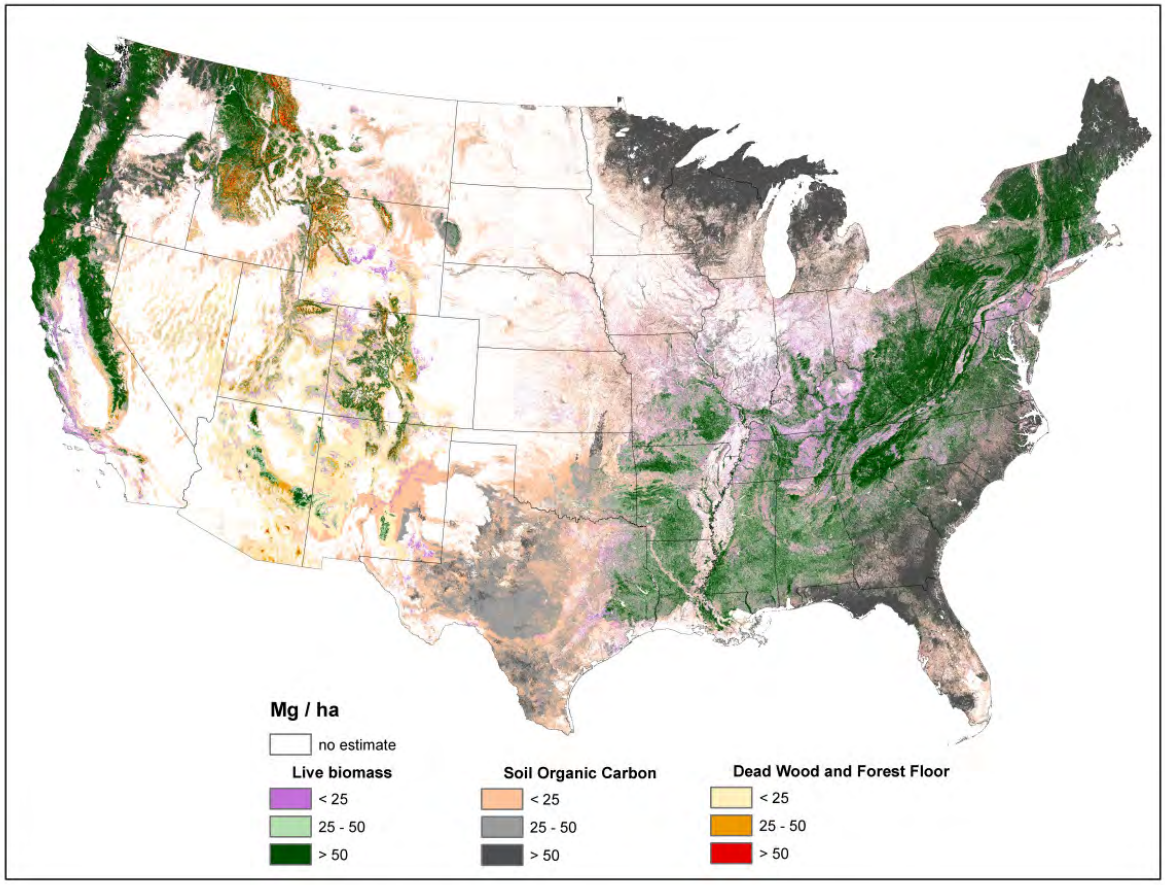


Figure 18. Major forest carbon pools. (Major forest carbon pools with the plurality of total forest carbon stock for each pixel imputed from forest inventory plots, conterminous U.S., 2000-2009. Major pools are: 1) living biomass (aboveground, belowground, and understory), 2) dead wood and forest floor (including standing dead, down dead, and forest floor), and 3) soil organic carbon (Wilson et. al. 2013). Mg / ha represents megagrams per hectare.)

Approximately 33% (749 million acres) of the United States' land base is forested. This represents roughly 7.5% of the world's total forestland. In 2010, forested lands and long-lived wood products accounted for a net sink of 251 million metric tons of carbon (922 million metric tons CO2). Forest growth and afforestation currently offset approximately 15% of U.S. emissions from burning fossil fuels. This is an enormous ecosystem service; offsetting another ten percent of emissions would require the conversion of one-third of our current U.S. cropland to forest plantations. While individual trees or tracts release some or all of their carbon if harvested, burned, or otherwise disturbed, subsequent forest regrowth will sequester carbon from the atmosphere. National forest lands covered in this decision are generally not subject to land-use change, and will remain as forests subject to federal protection. Forested landscapes tend to include a mix of disturbed and regrowing forest stands, and have a carbon balance of near zero

over the medium and longer term. Management actions should be examined for large areas and over long time periods (Figure 19). This figure models how carbon stores change as a larger area and more stands are included in an analysis. As the number of stands increases, the gains in one stand tend to be offset by losses in another, and hence the flatter the carbon stores curve becomes (Ryan, et. al. 2012).

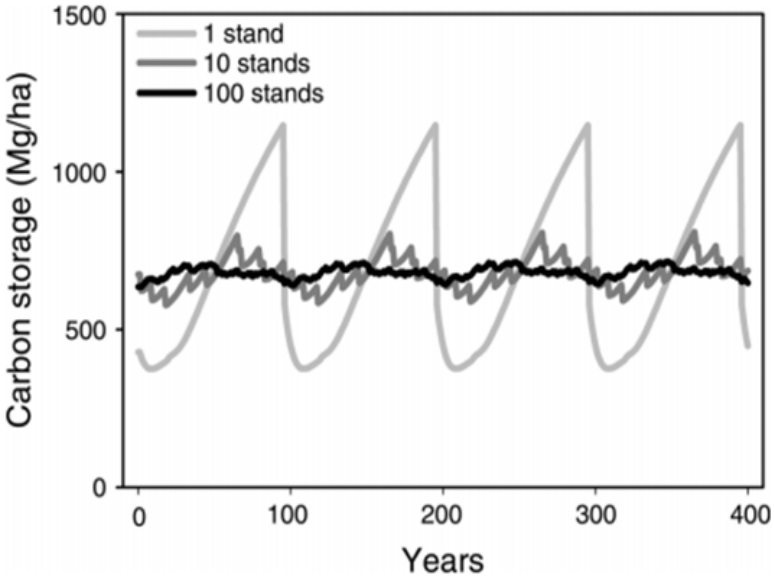


Figure 19. Model of carbon storage - Increase in Stands and Time.

This figure models how carbon stores change as a larger area and more stands are included in an analysis. As the number of stands increases, the flatter the carbon stores curve becomes. Mg/ha represents megagram per hectare.

The large flux of carbon from forests to the atmosphere (from logging and deforestation) peaked in 1915 at 760 million metric tons of carbon per year. Currently forests take up about 250 million metric tons of carbon per year. Our large carbon sink today is a legacy of harvesting and forest conversion that took place in the past. These disturbances released much carbon dioxide (CO2) into the atmosphere decades ago, and the regrowing forest is recovering some of that released CO2 on land that has not been permanently converted to non-forest cover (Figure 20).

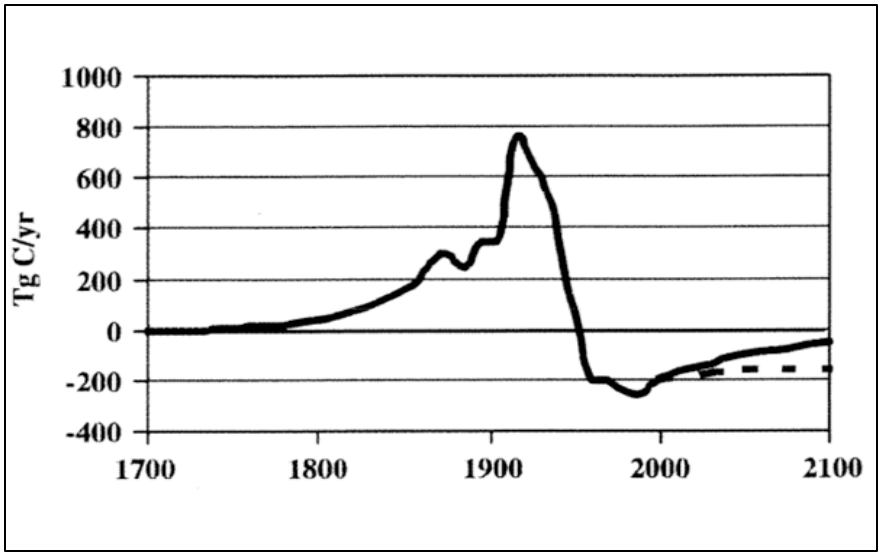


Figure 20. Carbon balance of a U.S. forest sector in millions of metric tons of carbon per year.

The large flux of carbon from forests to the atmosphere (from logging and deforestation) peaked in 1915 at 760 million metric tons of carbon per year. Currently forests sequester about 250 million metric tons of carbon per year. Tg = 1 million metric tons. Tg C or TgC Eq represents teragrams of carbon dioxide equivalent.

The persistence of the current U.S. forest carbon sink is uncertain because the effects of historic land use should taper off, while projected increases in the rates of natural disturbances such as fire may liberate current carbon stocks. Atmospheric factors may change forest growth rates, since increased nitrogen deposition and atmospheric CO2 concentrations from fossil fuel emissions can enhance tree growth. These factors may also augment current rates of carbon sequestration by forests. However, other global change factors, such as increased transpiration rates and atmospheric pollutants and the likelihood of increased drought, may offset potential increased sequestration rates.

Expected Changes

Over the next fifty years carbon stocks are likely to be more vulnerable to disturbances that are exacerbated by climate change, such as insect outbreaks, fire, drought, and storms. This may in turn lower the productivity and storage capacity of some forests while threatening the ability of some forests to remain forests. Because of more frequent/repeat burning, some forests may convert to shrubland. The effects of climate change are likely to affect forested landscapes in the eastern and western U.S. differently. The following are examples of what may occur, but does not represent a comprehensive list:

- In the eastern U.S., elevated temperature and atmospheric CO2 concentrations will likely continue to enhance sequestration by forests, but this sequestration may be offset by forest fragmentation and disturbances by invasive insects.
- In the Southeast, warmer temperatures may increase the rate of decomposition of soil organic matter, thereby increasing CO2 emissions and reducing the potential for sequestration in soils.
- In the western U.S., elevated temperatures and decreased precipitation is expected to lead to drought conditions that will exacerbate stress complexes that include fire and insect disturbance. Insect infestations are expected to affect more land than wildfire on an annual basis. Higher tree mortality, slower regeneration, and changes in the mix of tree species may result from these disturbances. While short-term effects will depend upon the amount of area affected, the cumulative impact of disturbances may turn western forests from a carbon sink into a source of atmospheric carbon (Ryan, et. al. 2012).
- Due to expected increases in dry weather, especially drought, more cases of SAD are expected. Suitability for aspen in the Southern Rockies is expected to deteriorate rapidly through the rest of the century, though some new areas may emerge as suitable habitat. Aspen forests, like other forest types, store considerable carbon in above and belowground biomass (and especially for aspen, in the soil). As stands mature and regenerate, there is a cycle of carbon release and sequestration with a high net storage of carbon. If aspen forests are replaced by shrub or meadow communities with lower carbon storage capacities, the difference will contribute to atmospheric CO2. Aspen mortality episodes in the aspen parkland of Alberta and Saskatchewan and in southwestern Colorado are expected to result in significant carbon release and positive feedbacks to climate change (Huang & Anderegg 2012, Michaelian et al. 2011).

In the decade since 2002, forest fires annually burned 0.9 percent of forested land in the United States, with the largest fire year (2006), burning 1.3 percent of forested land. This corresponds to an overall average return interval of 100 years for U.S. forest fires. Models run with downscaled climate data for the Greater Yellowstone Ecosystem predict substantial increases in fire in this region by mid-century, with fire rotation reduced to less than 30 years from the current 100-300 year return interval. If fires become more severe, especially where ecosystems are not adapted to severe fire, the likelihood that fire will change forest to shrublands or grasslands may increase. Annual carbon emissions related to fire vary considerably depending upon the year. Circumstances that directly affect fire activity include atmospheric circulation, temperature, and moisture patterns. Estimates of fire-related emissions range from 22.6 million metric tons/year (2010) to 84.4 million metric tons (2006), compared to net forest sequestration of 251 million metric tons/year (Ryan, et. al. 2012).

Options for Management

Options for managing forests for carbon storage are:

- Keep forests as forests (avoid deforestation), including active regeneration of frequent fire forests subjected to crown fires where natural regeneration may take centuries.
- Manage forests sustainably for a variety of ecosystem services (maximizing carbon stores on a landscape in the near-term may ultimately lead to more uncertain carbon outcomes, due to an increased risk of fire or disturbance in the mid- to long-term).
- Reforest areas where forests historically occurred.
- Substitute forest biomass for fossil fuel use, especially forest biomass generated in normal operations, fuels treatment and forest restoration activities.
- Promote long-lived forest products such as wood-framed buildings. Long-lived forest products continue to act as carbon stores whereas substitute materials, such as concrete, result in significant carbon emissions.

Harvest and regeneration of young to middle-aged forests for long-lived forest products can help with carbon storage. In forests with an ecological history of surface and mixed-severity fires, managing for maximum carbon storage will lead to an increase in stand density and the probability of more severe fires. In contrast, managing to reduce fuels and the risk of crown fire will reduce the carbon stored in the forest and will likely be a source of atmospheric carbon unless the thinnings are used for wood products. Fuels treatments and forest restoration activities in frequent-fire forests will promote a more adaptable, sustainable forest that tends to experience low intensity fires instead of crown fires. However, such treatments may move carbon from the forest to the atmosphere. Intensive biomass use could also move carbon from the forest to the atmosphere, at least in the short term. Carbon should be only one of the many factors considered when making forest management decisions (Ryan, et. al. 2012).

Carbon Sequestration on the GMUG

In 2013 the USDA Forest Service completed an assessment of carbon storage for all National Forests, based on Forest Inventory and Analysis (FIA) data. The assessment is intended to be used in Forest planning and results are summarized in the following charts. The assessment shows that overall carbon stocks have been increasing. On the GMUG, from 1990 to 2013, carbon stocks have fluctuated around approximately 130 Tg (teragrams), Figure 21.

In the Rocky Mountain Region, National Forest System Lands have increased since 1990, and forest ecosystem carbon storage in the area has also increased. From 1990 to 2013, overall carbon densities (tonnes/acre) have increased for the national forests and grasslands in the Rocky Mountain region with the GMUG having the third greatest levels of density compared to eleven other national forests and grasslands.

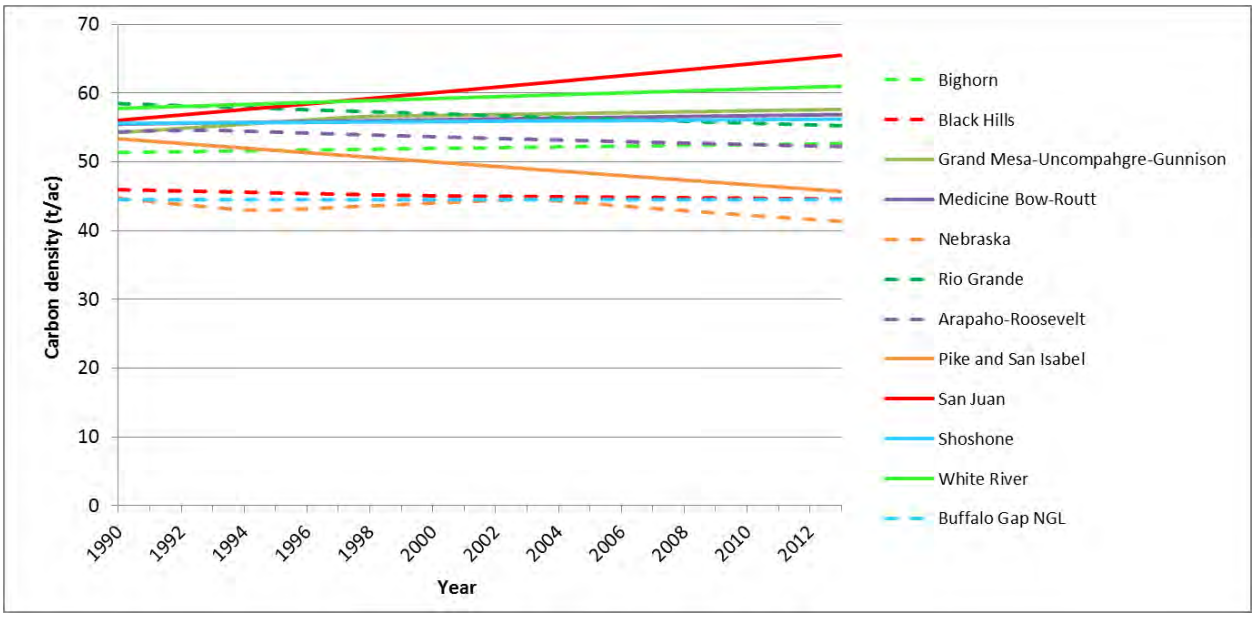


Figure 21. Carbon density (tonnes/acre) for the national forests and grassland in the Rocky Mountain Region (1990 -2013).

The Intergovernmental Panel on Climate Change (IPCC) production accounting approach was used to estimate harvested wood products (HWP) carbon storage from 1906 to 2012 for the Rocky Mountain Region. For the Rocky Mountain Region as a whole, carbon stocks in the HWP pool were increasing at approximately 180,000 megagrams of carbon (MgC) per year in the early 1950s through 1995 when carbon stocks plateaued until 2005 followed by the peak cumulative storage to date of 12 million MgC occurring in 2013. Net positive flux into the HWP pool over this period is primarily attributable to high harvest levels in the early1950s through the 1990s. In the years between the mid-1960s and 1990 timber harvests were at high, volatile levels, with high harvests of over 800,000 ccf (600,000 MgC) occurring six times during this period. Harvest levels from National Forests of the Rocky Mountain Region have since declined to less than 470,000 ccf (350,000 MgC) per year, resulting in less carbon entering the HWP pool. With the exceptions of 1998, 2003 and 2004, when emissions from HWP at solid waste disposal sites (SWDS) exceeded additions from harvesting, the Rocky Mountain Region HWP pool has remained in a period of positive net annual stock change because additions of carbon to the HWP pool through harvest exceeds the decay of products harvested between 1906 and 2012 (Figures 22 and 23) (Stockmann et. al. 2014). From 1990 to 2013 carbon stocks on the GMUG have approximated 130 Tg (Figure 24).

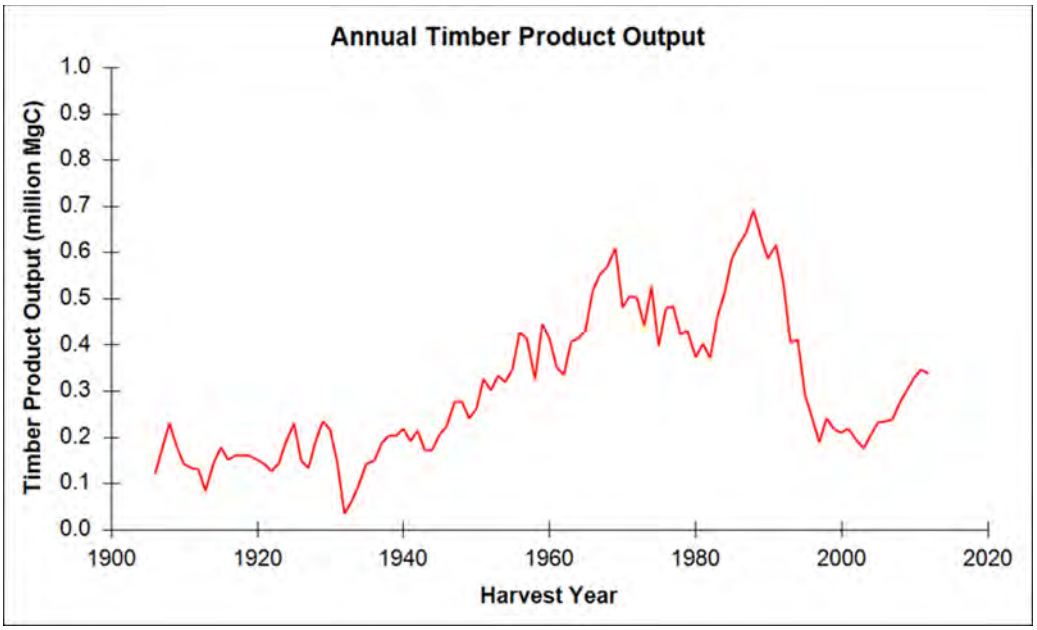


Figure 22. Annual timber product output in the Rocky Mountain Region (1906 to 2012).

Harvest estimates are based on data collected from USDA Forest Service Archives and Cut/Sold reports.

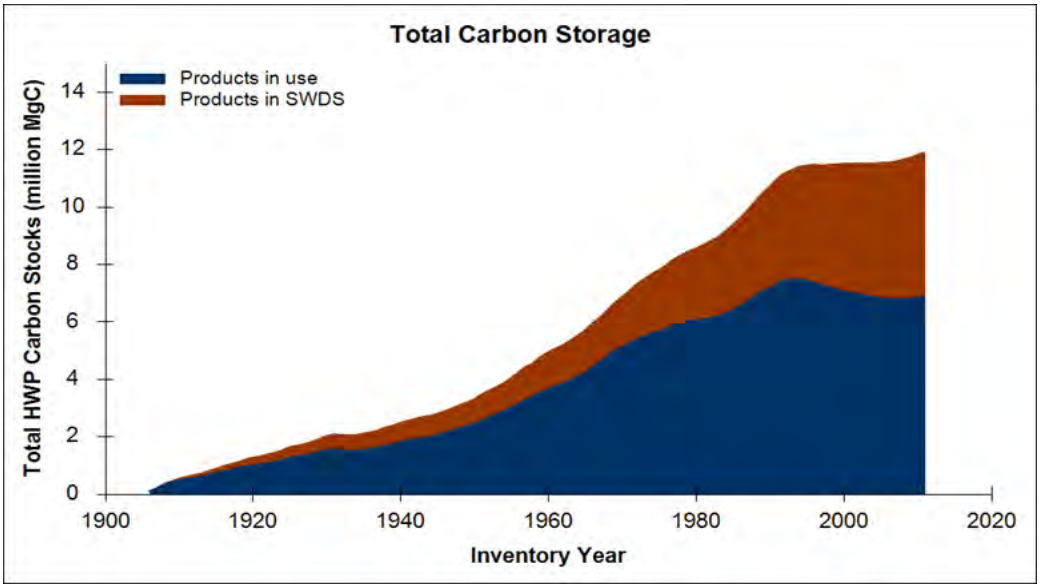


Figure 23. Cumulative total carbon stored in harvested wood products (HWP) manufactured from Northern Region timber using the IPCC/EPA approach.

Carbon in HWP includes both products that are still in use and carbon stored at SWDS, including landfills and dumps (millions of megagrams of carbon).

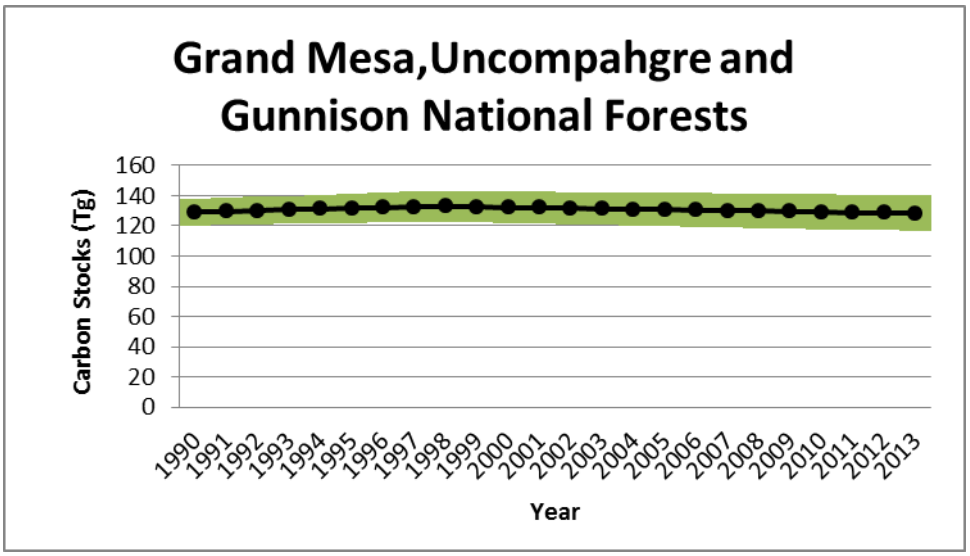


Figure 24. Carbon stocks on the GMUG from 1990 to 2013.

In Figure 24, the green band shows the range of analysis uncertainties.

Visibility

Visibility is specifically identified in the Clean Air Act as an AQRV that Federal land managers must consider. The 1990 CAA amendments include a goal of improving visibility in Class I areas with visibility impairment. Regional haze is visibility impairment resulting from the transport of particles over long distances. Visibility impairment is caused by pollutant plumes, layered haze, or uniform (regional) haze. Plumes are distinct in form and caused by a local source.

To address different ambient conditions, a uniform standard of measure, called a “deciview”, has been developed to describe changes in visibility. Specifically, it is a measure of light extinction. A change of 1.0 deciview is equivalent to a ten percent change in extinction and represents a “just noticeable” change in visibility. The higher the deciview, the less a person can see into the distance.

The Forest Service has conducted limited visibility monitoring using camera images in the West Elks Wilderness (1992 to 1996) and the La Garita Wilderness (1997 to 2001) to document visibility conditions in those Class I areas. The La Garita site showed a uniform haze during more than 70 percent of the sampling period (USDA Forest Service 2006d).

As part of the Colorado State Implementation Plan for Regional Haze, the CDPHE has calculated baseline and natural visual range values for the Maroon Bells-Snowmass and West ElkWilderness areas (9.6 deciviews baseline; 6.54 deciviews natural condition) and La Garita

Wilderness Areas (10.3 deciviews; 6.24 deciviews natural condition), pertinent to the SBEADMR planning area. Natural visibility represents visibility conditions experienced in the absence of human-caused impairment.

The Regional Haze Regulations (under 40 CFR §51.308) establish that the Class I area progress goals must provide for an improvement in visibility for the most impaired (i.e., 20% worst) days over the period of the implementation plan, and ensure no degradation in visibility for the least impaired (i.e., 20% best) days over the same period.

National Ambient Air Quality Standards (NAAQS)

Carbon Monoxide

Carbon Monoxide (CO) is a colorless and odorless gas, formed when carbon compounds in fuel are not burned completely. It is a component of motor vehicle exhaust, which contributes about 50 percent of all CO emissions nationwide, and as much as 85 percent of all CO emissions in cities. Peak CO concentrations typically occur during the colder months of the year when CO automotive emissions are greater, and nighttime temperature inversions (conditions where air pollutants are trapped near the ground beneath a layer of warm air) are more frequent (United States Environmental Protection Agency 2009; CAQDR 2012).

In Colorado, CO concentrations have dropped dramatically from the early 1970s. This change can be seen in both the concentrations measured and the number of monitors that exceeded the level of the 8-hour standard. In 1975, 9 of the 11 (81%) state-operated monitors exceeded the 8-hour standard. In 1980, 13 of the 17 (77%) state-operated monitors exceeded the 8-hour standard. Since 1996 none of the state-operated monitors have recorded a violation of the 8-hour standard. Table 34 shows CO monitoring data for seven counties in the GMUG region where data is available from 2012-2014.

Lead

Lead is a metal found naturally in the environment as well as in manufactured products. Due to the phase out of leaded gasoline for automobiles, piston engine aircraft and metals processing are now the major source of lead emissions to the air today. The highest levels of lead in air are generally found near lead smelters and general aviation airports. Other stationary sources are waste incinerators, utilities, and lead-acid battery manufacturers. (United States Environmental Protection Agency 2007) (CAQDR 2012).

In Colorado the last violation of the previous 1.5 µg/m3 lead standard occurred in the first quarter of 1980 at the Denver CAMP monitor. Since then, the concentrations recorded at all monitors showed a steady decline. This decline is the direct result of the use of unleaded gasoline and replacement of older cars with newer ones that do not require leaded gasoline. The reduction

in atmospheric lead shows what pollution control strategies can accomplish. In 2006, monitoring for lead by the CDPHE was reduced from six locations to one. In 2007, that lead monitor was moved from the Denver CAMP location to the Denver Municipal Animal Shelter NCore site at 678 S. Jason St. (CAQDR 2012).

Nitrogen Dioxide

In its pure state, NO_2 is a reddish brown gas with a characteristic pungent odor. It is corrosive and a strong oxidizing agent. As a pollutant in ambient air, however, it is virtually colorless and odorless. NO_2 can be an irritant to the eyes and throat. Oxides of nitrogen (nitric oxide and NO_2) are formed when the nitrogen and oxygen in the air are combined in high temperature combustion (CAQDR 2012).

Colorado exceeded the NO2 standard in 1977 at the Denver CAMP monitor. Concentrations have shown a gradual decline for the past 20 years. However, the trend of annual averages for the past ten years has been nearly flat. Denver CAMP monitor has shown little to no change at all. The cause of this is most likely due to an increase in the number of vehicles and increased power generation associated with the increases in population in the Denver-metro area (CAQDR 2012). Table 24 shows nitrogen oxide monitoring data for seven counties in the GMUG region where data is available from 2012-2014.

Particulate Matter

Ambient particulate matter (PM) concentrations increase substantially during a wildfire (Kochi et al. 2010b). A dose-response function is an equation that estimates the health consequences of exposure to pollution. Compared to conventional PM studies (based on urban air pollution), wildfire studies are “less likely to find a significant positive mortality effect in spite of the substantial increases in PM levels during the wildfire period” (Kochi et al. 2010a). There are several probable reasons for this finding, including: (1) urban air pollution and wildfire smoke are chemically different (wildfire smoke is generally less toxic), (2) wildfire events are more likely to promote averting behavior, such as evacuation (Kochi et al. 2010a). However, the wildfire studies did find increased hospital admissions linked to asthma and respiratory problems during wildfire events (Kochi et al. 2010a).

Smoke can travel great distances and affect communities far away from the burn unit, sometimes persisting after the burn has been completed. Particulates become part of the air mass where they were released, gradually dispersing to a more uniform concentration within the air mass until gravity or precipitation brings them back to earth days or weeks later.

Under the existing condition, dead trees in the GMUG are providing an increase to surface fuels that over many years and could increase smoke emissions from wildland fires. Wildland fires are

unpredictable as to when they occur, their size and intensity, and the amounts and duration of smoke production that can impact human health and visibility. The timing of prescribed fires is predictable, the volume of smoke produced is typically less than in a wildfire, and there is time to notify the public when burns will be implemented. As a result, adverse health consequences are less likely to result from prescribed fires. In addition, given the remoteness of the majority of the area proposed for burning, smoke would not be a human health concern for the adjacent communities. However, under the No Action Alternative, health and human safety impacts from wildfire smoke may be higher than the other alternatives.

PM10

The size of particles is directly linked to their potential for causing health problems. Small particles, less than 10 micrometers (microns) in diameter, pose the greatest problems. Since PM_{10} contains all particles smaller than 10 microns, $PM_{2.5}$ and ultrafine particles which are <0.1 microns are included in the PM_{10} measurement. The smallest particles, like $PM_{2.5}$, can get deep into the lungs, and some, like ultrafine particles, can penetrate all the way into the bloodstream. Exposure to such particles can affect the lungs, the heart, and the cardiovascular system. Larger particles are of less concern, although they can irritate the eyes, nose, and throat (AirNow 2003), and cause serious harm due to inflammation in the airways of people with respiratory diseases such as asthma, chronic obstructive pulmonary disease, and pneumonia (Weinmayr, et al. 2010; CAQDR 2012).

PM_{10} data have been collected in Colorado since 1985. The samplers were modified in 1987 to conform to the requirements of the new standard when it was established in July of 1987. Therefore, annual trends are only valid back to July 1987. Since 1988, the state has had at least one monitor exceed the level of the 24-hour PM_{10} standard (150 µg/m3) every year except 2004. By contrast, no monitor with at least 75 percent data recovery per calendar quarter, which is required for NAAQS comparisons, has exceeded the level of the former standard (50 µg/m3 as an annual arithmetic mean averaged over 3 years) (CAQDR 2012).

One exceedance of the PM10 24-hour standard occurred at a monitor in Grand Junction, in Mesa County, in 2010. A large regional wind and dust event occurred on the day of the exceedance, with exceedances recorded at other locations in western Colorado including Durango, Crested Butte, Rifle, and Clifton. The Colorado Air Pollution Control Division has therefore requested EPA to flag this day as an exceptional event (pers. comm., Debra Miller, USFS, with Bradley Rink, Particulate Matter Monitoring Lead, Colorado Air Pollution Control Division, July 11, 2012). Exceptional events are defined as “unusual or naturally occurring events that can affect air quality but are not reasonably controllable using techniques that tribal, state or local air agencies may implement in order to attain and maintain the National Ambient Air Quality Standards” (Environmental Protection Agency 2013). A day that is determined by EPA to

qualify as an exceptional event is not used to determine whether a violation of the ambient air quality standard has occurred, and therefore the 2010 exceedance that occurred at the Grand Junction monitor is not shown in the table above.

In cases other than exceptional events, and more so than other pollutants, PM_{10} is a localized pollutant where concentrations vary considerably. Thus, local averages and maximum concentrations of PM_{10} are more meaningful than averages covering large regions or the entire state. The CDPHE has concluded that it is inappropriate to display a state-wide average graph for PM10 (CAQDR 2012). Annual estimated emissions inventories are useful for comparing emissions from various sources and Figure 25 and Table 24 shows the low amount of PM_{10} emissions from prescribed burning in Colorado compared to stationary and mobile sources from 1992 to 2010 (the latest information available) (CDPHE 2010a).

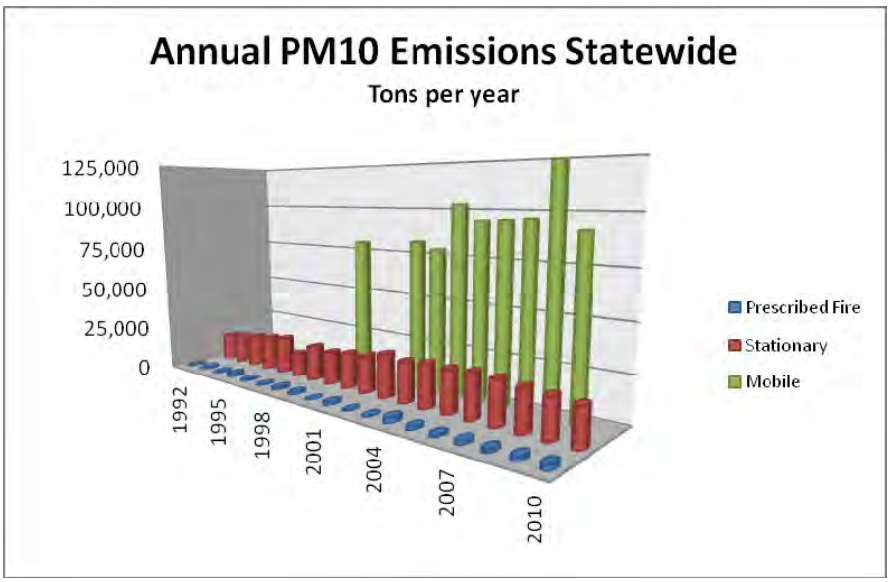


Figure 25. Comparison of the particulate matter emissions from prescribed fire vs. other emission sources in Colorado.

Although a prescribed fire treatment may cause significant, short-term impacts to an area, the total emissions from prescribed fire are orders of magnitude less than emissions from stationary and mobile sources (CDPHE 2010a).

Table 24. Comparison of the Particulate Matter Emissions from Prescribed Fire vs.

Other Emission Sources. Prescribed fire and stationary sources, including portable and fugitive dust, produced an average of 1,547 and 20,616 tons respectively of PM10 emissions per year over nineteen years. Fugitive dust, or dust not coming from a combustion source, accounts for about 90% of all primary PM10 emissions. Mobile sources produced an average of 93,445 tons of PM10 emissions per year over nine years. Although a prescribed fire

treatment may cause significant, short-term impacts to an area, the total emissions from prescribed fire are orders of magnitude less than emissions from stationary and mobile sources (tons) (CDPHE 2010a).

Annual PM_{10} Emission Inventory for Various Colorado Sources from 1992 to 2010 *(Tons per Year)*			
Year	**Prescribed Fire**	**Stationary Sources (includes portable and fugitive dust)**	**Mobile-Statewide (includes tailpipe and road dust emissions)***
1992	627	15,364	unknown
1993	1,646	16,452	unknown
1994	895	18,185	unknown
1995	2,267	19,783	unknown
1996	1,298	21,215	unknown
1997	709	13,897	unknown
1998	1,684	20,115	unknown
1999	1,633	18,916	80,229
2000	390	20,491	unknown
2001	1,747	21,384	unknown
2002	666	24,518	82,376
2003	910	22,715	78,671
2004	3,093	23,852	98,600
2005	1,726	23,509	94,565
2006	1,447	24,385	95,173
2007	1,988	23,802	96,106
2008	1,934	22,206	123,606
2009	2,195	21,105	91,685
2010	2,533	19,814	not yet available

$PM_{2.5}$

EPA generally defines $PM_{2.5}$ as particulate matter with an aerodynamic diameter less than or equal to 2.5 microns in size. The health effects of $PM_{2.5}$ are a function of their size and composition. These tiny particles can be breathed deeply into the alveoli of the lungs and may cause a great deal of damage to lung tissue, reducing lung function and causing or aggravating respiratory problems. They can increase the long-term risk of lung cancer or lung diseases such as emphysema or pulmonary fibrosis. The smallest range of $PM_{2.5}$ particles, also called ultrafine particles (those with a diameter <0.1 μm) can be transported from the lungs into the blood stream and affect the heart and cardiovascular system (Cardiovascular Toxicology 2006). Once in the blood stream, ultrafine particles can be transported anywhere in the body. Some of these ultrafine particles are carcinogenic (CAQDR 2012).

Fine particulate matter (PM2.5) is chiefly comprised of five mass types: organic mass, elemental carbon (also known as soot or black carbon), ammonium sulfates, ammonium nitrates, and crustal materials (i.e., soil). Primary fine particulate emissions result from combustion processes (including fossil fuel combustion and biomass combustion that occurs in wild fires) and include black carbon. In general, however, black carbon and crustal materials comprise a relatively small proportion of the fine particulate mass suspended in the atmosphere. The largest constituents of fine particulate are usually organic mass, ammonium nitrates, and ammonium sulfates. Some fine particulates (PM2.5), particularly ammonium sulfate and ammonium nitrate particles, can also be formed in the atmosphere from the interaction of either SO2 or nitrogen oxides with ammonium. These types of PM2.5 particles are referred to as secondary particulates, while particles emitted directly from a source are referred to as primary particulates. Secondary particulates do not result from emissions of fugitive dust.

Monitoring for $PM_{2.5}$ in Colorado began with the establishment of sites in Denver, Grand Junction, Steamboat Springs, Colorado Springs, Greeley, Fort Collins, Platteville, Boulder, Longmont, and Elbert County in 1999. By 2004, there were 20 $PM_{2.5}$ monitoring sites in Colorado. Thirteen of the 20 sites were selected based on the population of the metropolitan statistical areas. In addition, there were seven special-purpose-monitoring (SPM) sites. These sites were selected due to historically elevated concentrations of PM_{10} or because citizens or local governments had concerns of possible high $PM_{2.5}$ concentrations in their communities. All SPM sites were removed as of December 31, 2006 due to low concentrations and a lack of funding (CAQDR 2012).

Though data has only been collected for the past 12 years, the levels of $PM_{2.5}$ appear to be essentially flat. Since the standard is based on a three-year average of the top 98th percentile of samples, the 24-hour standard has not been violated at any site. Neither has the three-year average annual standard of 15 µg/m3 (CAQDR 2012). Table 25 shows PM2.5 monitoring data for seven counties in the GMUG region where data is available from 2012-2014.

Ozone

Ozone (O_3) is a gas composed of three oxygen atoms. Ozone has the same chemical structure whether it occurs miles above the earth or at ground-level and can be beneficial or detrimental, depending on its location in the atmosphere (CAQDR 2012). Ground-level ozone is of concern to human health. Motor vehicle exhaust and industrial emissions, gasoline vapors, and chemical solvents as well as natural sources emit NO_X and VOCs that help form ozone. Ground level ozone is the primary constituent of smog.

In the stratosphere the beneficial ozone layer extends upward from about 6 to 30 miles and protects life on Earth from the sun's harmful ultraviolet (UV) rays. This natural shield had been gradually depleted by man-made chemicals like chlorofluorocarbons (CFCs), though evidence suggests that the total ozone column has not decreased since 1998 (Weatherhead 2006). A depleted ozone shield allows more UV from the sun to reach the ground, leading to more cases of skin cancer, cataracts, and other health problems (Environmental Protection Agency 2012d).

In Colorado ozone monitoring began in 1972 at the Denver CAMP station, and eight exceedances of the then-applicable 1-hour standard were recorded that year. In the Denver metropolitan area ozone averages have fluctuated around the standard and in recent years, the trend has been downward, but the averages seem to fluctuate within the amount of variance seen for the last several years (CAQDR 2012).

Unlike most other criteria pollutants, ozone is not emitted to the atmosphere directly; it is formed when nitrogen oxides and volatile organic compounds react in the presence of sunlight. In general, ozone concentrations in the lower atmosphere are highest during warmer months and lower in the cooler months. In some parts of the western U.S., high winter-time ozone concentrations have been monitored. The project area is not in an airshed with monitored high winter-time ozone concentrations. The chemical reactions that form ozone are complicated and nonlinear, making it difficult to predict ozone concentrations that will result from increasing the amount of the ozone precursors (i.e., nitrogen oxides and volatile organic compounds) in the atmosphere. The effect of adding nitrogen oxides or volatile organic compounds to the atmosphere on the concentration of ozone depends upon the ratio of the two precursors already present. Ozone formation is also highly dependent on meteorological conditions, including temperature, wind speed, and solar radiation. Ozone in the lower atmosphere is harmful to human health and vegetation. Some fine particulates (PM2.5), particularly ammonium sulfate and ammonium nitrate particles, can also be formed in the atmosphere from the interaction of either SO2 or nitrogen oxides with ammonium.

Smoke can increase ozone production and the CDPHE has taken measures to limit prescribed burning during ozone alerts that mostly affect the Denver metropolitan area. Smoke from fires can be major sources of ozone and their overall role in the formation is not well understood. There are some indications that smoke enhances ozone formation and also some indications it inhibits ozone formation. In the instances where smoke is suspected of decreasing ozone formation, the smoke was very heavy and perhaps blocked the strong sunlight associated with ozone formation. The CDPHE recommends that agencies should err on the side of caution about any relationship between ozone and the burning of wildland fuels (CDPHE Memorandum, Re: Prescribed Fire Smoke Permits, Use of Ozone Alert Information, 8/5/10). Table 25 shows ozone monitoring data for seven counties in the GMUG region where data is available from 2012-2014.

Sulfur Dioxide

Sulfur dioxide (SO_2) belongs to the family of sulfur oxide gases (SO_x). Most SO_2 comes from electric utilities, particularly those that burn coal. Sulfur dioxide can react with other substances in the air to form small particles that can cause or worsen respiratory disease, aggravate existing heart disease, and form acid rain. Nationwide, SO_2 concentrations have decreased over time. In Colorado, long term monitors along the Front Range indicate annual average SO_2 values of 0.01 ppm or less which are well below the NAAQS (Environmental Protection Agency 2010; CAQDR 2012).

Table 25. Air Pollutant Monitoring Results for Selected Counties in Western Colorado.

The table shows monitoring data for seven counties in the GMUG region where data is available from 2012-2014. (EPA Air Quality Statistics Report, http://www.epa.gov/airdata/ad_rep_con.html)

County	CO 1-hr 2nd Max	CO 8-hr 2nd Max	NO2 98th %ile	O3 1-hr 2nd Max	O3 8-hr 4th Max	SO2 99th %ile	SO2 24-hr 2nd Max	PM2.5 98th %ile	PM2.5 Wtd. Mean	PM10 24-hr 2nd Max
2012										
Delta	.	.	.	.	.	.	.	.	.	58
Garfield	.	.	.	0.1	0.082	.	.	.	.	46
Gunnison	.	.	.	0.08	0.07	.	.	.	.	91
La Plata	0.8	0.6	29	0.08	0.069	.	.	10	4.3	59
Mesa	1.6	1	.	0.09	0.073	.	.	24	7.3	143
Montezuma	.	.	.	0.08	0.07	.	.	12	5.6	.
San Miguel	.	.	.	0.08	0.063	.	.	.	.	68
2013										
Delta	.	.	.	.	.	.	.	.	.	44
Garfield	.	.	.	0.07	0.067	.	.	.	.	34
Gunnison	.	.	.	0.07	0.064	.	.	.	.	61
La Plata	1.7	1	35	0.08	0.072	.	.	29	4.5	38
Mesa	1.4	0.9	.	0.07	0.066	.	.	40	8.8	56
Montezuma	.	.	.	0.08	0.069	.	.	12	6.1	.
San Miguel	.	.	.	0.07	0.069	.	.	.	.	58

County	CO 1-hr 2nd Max	CO 8-hr 2nd Max	NO2 98th %ile	O3 1-hr 2nd Max	O3 8-hr 4th Max	SO2 99th %ile	SO2 24-hr 2nd Max	PM2.5 98th %ile	PM2.5 Wtd. Mean	PM10 24-hr 2nd Max
2014										
Delta	.	.	.	.	.	.	.	.	.	49
Garfield	.	.	.	0.07	0.061	.	.	.	.	42
Gunnison	.	.	.	0.07	0.063	.	.	.	.	97
La Plata	1.3	1	24	0.08	0.067	.	.	6	3.4	34
Mesa	1.7	0.9	.	0.07	0.062	.	.	21	8.2	45
Montezuma	.	.	.	0.07	0.065	.	.	9	5.2	.
San Miguel	.	.	.	.	.	.	.	.	.	68

Desired Condition

The desired condition for the GMUG National Forest is as follows:

- Maintain Class I air quality conditions for those designated areas on the GMUG. Do not allow on-forest activities to elevate emissions to levels of non-attainment for the Class II areas.
- Coordinate with local, regional, and State interests to resolve regional air quality emission issues that may influence air quality and visibility on the GMUG.

Fuels management treatments that rely on burning would need to incorporate air quality management practices with regards to timing and atmospheric conditions to minimize particulate emissions.

Risks to Achieving Desired Conditions

- Wildfire, because of its unpredictable and unplanned timing, is the greatest threat to air quality on the GMUG.
- Increasing urbanization of communities surrounding the GMUG has the potential to increase fossil-fuel emissions related to increased vehicle trips and traffic.
- Development of oil and gas, and to a lesser extent coal-fired power generation plants within the region could increase emissions that would further impact visibility or cause impacts on high elevation receptors, such as sensitive alpine vegetation, lakes, and streams in the Wilderness areas on the GMUG.

Performance measures include:

- Non-attainment conditions
- Source emissions

- Visibility ratings

Alternative 1 (No Action) – Direct and Indirect Effects

This alternative is used as a basis for comparing the effects of the Proposed Action and other alternatives. It assumes no implementation of the Proposed Action. Under Alternative 1, there would be no additional project-related prescribed burning or equipment use. Managed Wildfire implementation would continue per existing authority and direction found in the LRMP. Current and future air quality conditions would remain the same or be similar to current conditions depending on regional urban, dust from roads, wind events, construction, transportation, fossil fuels exploration and production, burning emissions growth from sources such as electrical power generation plants, and other planned and approved vegetation management projects. However, as dead trees fall and surface fuels increase over one to two decades, the potential for wildfires and Managed Wildfire to produce more smoke would increase due to heavier surface fuel loads burning and possibly larger fire areas burning due to an increase in the resistance to control.

An increase in wildfire smoke emissions increases air quality impacts in smoke sensitive areas and Class I areas. Concentrations of possibly unhealthy levels of particulate matter and carbon monoxide occurs in occupied smoke sensitive areas immediately adjacent to burning wildfires. Particulate matter can travel tens or even hundreds of miles depending on the amount of smoke produced and meteorological conditions, and cause air quality impacts to smoke sensitive areas and Class I airs sheds downwind. Particulates become part of the air mass where they were released, gradually dispersing to a more uniform concentration within the air mass until gravity or precipitation brings them back to earth days or weeks later. As carbon monoxide moves further away from the burning source it degrades and reduces back into its original constituents, and generally would not pose a health problem several miles or further away from the source. Wildfire smoke NOx and VOC could increase or decrease ozone production depending on the amounts of smoke present during the day time and whether the smoke plume is dense enough to limit the interaction of sunlight with ozone precursor constituents (CDPHE 2010b).

Though difficult to quantify, dying and dead spruce and aspen stands would become a source of GHG over time as plant tissues cease to photosynthesize (and thus cease to sequester) and eventually decompose. However, the amount of GHG emitted from decomposition would be offset to an unknown degree by the growth of vegetation that would occupy sites opened up by forest mortality (Ryan et. al. 2012). The same type of phenomenon would occur if the forests were burned by wildfires. The wildfires would produce large amounts of GHG emissions and reduce sequestration in the short-term. Dead trees and plant tissue would decompose producing more GHG emissions, but would be offset to an unknown degree by new plant growth over the long-term.

Alternative 1 – Cumulative Effects

There are no proposed management activities under Alternative 1. Therefore, no changes to air quality would result from the implementation of the No Action Alternative.

With respect to ongoing and reasonably foreseeable actions that could result in cumulative impacts to air quality, prescribed burns authorized by other decisions in the project area would result in short-term smoke and its associated PM10 emissions. In addition, increased population growth near the GMUG results in increased emissions from transportation both on and off Forest System lands, as well as more wood-burning.

Carbon

Under the No Action Alternative, some areas would be salvaged or treated via other decisions, but to a lesser degree than under the Action Alternatives. Untreated high-mortality stands would remain a net source of carbon for the long-term, until if and when regeneration results in a rate of carbon sequestration that outpaces the carbon source of decomposing biomass.

Alternative 2 (Proposed Action) – Direct and Indirect Effects

Under Alternative 2, direct air quality effects would be the production of emissions from equipment used to implement project work, road dust and smoke emissions from prescribed burning.

Equipment use over the approximately 8-12 year implementation timeframe of the project would include only tens of gasoline or diesel fuel powered vehicles and specialized tree harvesting equipment on any given day, spread out over a large area. Therefore the amount of emissions the equipment would produce would be insignificantly small and generally unknowable because we do not know exactly where, when and how many acres would be treated, the number of and types of vehicles/equipment that would be used, miles driven and their hours of operation. In most circumstances vehicle and equipment emissions disperse rapidly and the potential concentrations caused by only tens of vehicles/equipment would not cause NAAQS exceedances.

GMUG staff provided daily production estimates for equipment that would be used in proposed SBEADMR logging operations. For Alternative 2, 990,000 CCF are estimated to be harvested over the life of the project and, based on that total harvest estimate, equipment emissions estimates were made using equipment daily production rates shown in Table 26.

Table 27 shows the total amount of logging equipment NAAQS and GHG emissions that would be produced in Alternative 2.

Table 26. Logging Equipment Types, Daily Production Rates, Equipment Horse Power and the Total Numbers of Operating Days Required to Completed Logging Operations Proposed in Alternative 2.

Equipment Type	Daily Production Rate	Horse Power	Alternative 2 Operating Days
Grapple Skidder	300 CCF/Day	175	2,800
Feller Buncher	367 CCF/Day	300	2,289
Stroke Delimber	200 CCF/Day	300	4,200
Loader	200 CCF/Day	175	4,200
Masticator	5 acres/Day	300	1,000
Chainsaw	100 CCF/Day	11	8,400
Pick-Up Truck	100 CCF/Day	N/A	8,400
Log Hauling Truck	10 CCF/Truck	N/A	49,500

Table 27. Total Amount of Logging Equipment NAAQS and GHG Emissions that would be Produced in Alternative 2 (tons).

PM10	PM2.5	CO	C02 (GHG)	CH4 (GHG)	NMHC	NOx	SO2
0.90	0.85	75.76	245.8	0.25	3.43	1.70	0.0022

Dust abatement would be applied in sensitive areas (for example near subdivisions or in campgrounds) at the individual treatment phase. transportation design features address dust abatement (Appendix B).

Prescribed burning would take place in spruce treatment units for reducing activity-related fuels and in aspen and aspen / conifer mixed stands for regenerating aspen. All prescribed burning operations are required to be permitted and comply with CDPHE Regulation 9 stipulations – see State Laws and Regulations above. The main purpose of Regulation 9 is to ensure that smoke emissions are limited to stay within the capacity of the atmosphere to disperse smoke and not cause exceedances of NAAQS in occupied smoke sensitive areas and protect Class I air sheds from degradation.

Activity fuels, or slash piles, would range in size from about 6 to10 feet high with a 100 to 400 square foot base up to 10 to 20 high, or 400-900 square feet (Design Feature SP-4 and SBEADMR Fuels Report). SP-4 also recommends keeping the total area covered by piles/acre under ~5% (<2,500 square feet/acre covered by piles). For the purposes of this analysis the medium size pile (10 feet high) smoke emissions are estimated using the Piled Fuels Biomass and Emissions Calculator, and total modeled pile square footage would not exceed approximately 2,000 square feet per acre. Aspen treatments would be accompanied by the lop

and scatter of activity fuels in the units to help reduce livestock access to the units in order to reduce browse pressure.

Table 28. Alternative 2 Estimated Range of Total NAAQS and GHG Emissions from Prescribed Burning of Small Slash Pile for the SBEADMR Project (Tons).

Treatment Scenario and Numbers of Slash Piles	SBEADMR Slash Piles Emissions Range - Tons						
	PM	PM_{10}	$PM_{2.5}$	CO	CO_2 (GHG)	CH_4 (GHG)	NMHC
Spruce Recovery Medium Size Machine Pile – 5/acre 117,000-175,500 piles total	6,926-10,389	5,136-7,682	4,364-6,527	19,503-29,172	853,994-1,277,342	1,439-2,152	1,158-1,732
Spruce Resiliency Medium Size Machine Pile – 1.67/acre 21,042-37,800 piles total	1,245-2,237	923-1,659	784-1,409	3,507-6,301	153,587-275,905	258-464	208-374
Non-commercial mechanical, hand treatments Small Hand Piles – 7-20/acre 70,000-200,000 piles total	364-1,040	259-740	224-640	1,260-3,600	55,300-158,000	91-260	70-200
Total	8,535-13,666	6,318-10,081	5,372-8,576	24,270-39,073	1,062,881-1,711,247	1,788-2,876	1,436-2,306

For treatments in aspen, the FOFEM model was used for estimating a range of potential broadcast prescribed burning emissions based on model default fuel loading values ranging from light, typical to heavy fuel loads that are burned under very dry and wet conditions. The model outputs provide a minimum and maximum range of emissions (
Table 29). Emission estimates for slash pile burning and aspen broadcast prescribed burning are combined and displayed in Table 30.

Table 29. Alternative 2 Estimated Emissions from Broadcast Prescribed Burning in Aspen (Tons Per Acre). The total emissions range column shows the range of emissions if 20,000 and 50,000 acres were treated over ten years.

NAAQS Criteria Pollutant and Greenhouse Gas (GHG)	Light Fuel Load Very Dry	Light Fuel Load Wet	Typical Fuel Load Very Dry	Typical Fuel Load Wet	Heavy Fuel Load Very Dry	Heavy Fuel Load Wet	Emissions Range per Acre	Total SBEADMR Emissions Range Over Ten Years (20,000 and 50,000 acres)	
								Light Fuel Load Wet	Heavy Fuel Load Very Dry
Particulate –	0.08	0.04	0.17	0.09	0.29	0.15	0.04-0.29	800-	2,000-

NAAQS Criteria Pollutant and Greenhouse Gas (GHG)	Light Fuel Load Very Dry	Light Fuel Load Wet	Typical Fuel Load Very Dry	Typical Fuel Load Wet	Heavy Fuel Load Very Dry	Heavy Fuel Load Wet	Emissions Range per Acre	Total SBEADMR Emissions Range Over Ten Years (20,000 and 50,000 acres)	
								Light Fuel Load Wet	Heavy Fuel Load Very Dry
PM_{10}								5,800	14,500
Particulate - $PM_{2.5}$	0.07	0.03	0.15	0.07	0.24	0.13	0.03-0.24	600-1,500	4,800-12,000
Methane - CH_4 – (GHG)	0.04	0.02	0.09	0.04	0.14	0.08	0.02-0.14	400-1,000	2,800-7,000
Carbon Monoxide - CO	0.86	0.37	1.96	0.94	3.22	1.65	0.37-3.22	7,400-18,500	64,400-161,000
Carbon Dioxide - CO_2 – (GHG)	5.01	2.89	10.83	6.56	19.22	11.54	2.89-9.22	57,800-144,500	184,400-461,000
Nitrogen Dioxide - NO_X	0.003	0.003	0.005	0.005	0.01	0.009	0.003-0.01	60-150	200-500
Sulfur Dioxide - SO_2	0.004	0.002	0.008	0.005	0.01	0.008	0.002-0.01	40-100	200-500

Table 30. Total Alternative 2 Estimated Emissions Range for the SBEADMR Project Over Ten Years (Tons).

NAAQS Criteria Pollutant and Green House Gas (GHG)	Treatment Type			
	Slash Pile Burning Minimum / Maximum Emissions (tons)	**Aspen Broadcast Burning Minimum / Maximum Emissions (tons)**	**Logging Equipment Emissions (tons)**	**Grand Total all Emissions - Minimum / Maximum Emissions (tons)**
PM	8,535-13,666	N/A	N/A	8,535-13,666 (1)
PM_{10}	6,318-10,081	800-14,500	0.90	7,119-24,582
$PM_{2.5}$	5,372-8,576	600-12,000	0.85	5,973-20,577
CO	24,270-39,073	7,400-161,000	75.76	31,746-200,149
CO_2 (GHG)	1,062,881-1,711,247	57,800-461,000	245.80	1,120,965-2,172,531
CH_4 (GHG)	1,788-2,876	400-7,000	0.25 (3)	2,188-9,876
NMHC	1,436-2,306	N/A	3.43	1,440-2,309 (1)
NOx	N/A (2)	60-500	1.70	60-501 (2)
SO_2	N/A (2)	40-500	0.0022	40-500 (2)

(1) FOFEM outputs for aspen broadcast burning do not include PM and NHMC. (2) Piled Fuels Biomass and Emissions Calculator outputs do not include NOx and SO2. (3) Emission factors available for only, and corresponding emissions estimates, Pick-up and Log Hauling Trucks.

Large amounts of smoke emissions would be produced each year over the implementation timeframe of approximately 8-12 years from prescribed burning of mechanical activity-related fuels in slash piles and broadcast burning in aspen and aspen / conifer mixed stands. Aspen does not burn under wet conditions no matter the fuel loading and that dry or very dry conditions are required before surface fuels will burn. Actual smoke emissions from broadcast prescribed burning in aspen would be in the upper range. Spruce slash piles generally will have a very high consumption rate of around 90 percent. The emission calculations made for this analysis assume that all acreage considered in the proposed action would be treated and all acres would be treated the same. Therefore, the estimate shows the maximum amount of emissions that theoretically could be produced. Compared to the Colorado emissions inventory (Table 25), implementation of Alternative 2 would produce an average of about 46-158% percent of statewide annual prescribed burning PM_{10} emissions, or a theoretical range of approximately 712-2,458 tons of PM_{10} per year. State-wide prescribed fire and stationary sources produced an average of 1,547 and 20,616 tons respectively of PM_{10} emissions per year over nineteen years from 1992 to 2010 (the last year data is available). Mobile sources produced an average of 93,445 tons of PM_{10}

emissions per year over nine years (Table 25). In comparison to stationary and mobile sources, SBEADMR would produce far less PM_{10} each year.

Class I Areas

Smoke from prescribed burning may temporarily reduce visibility from one day to several days at a time in Maroon Bells-Snowmass, La Garita, West Elk Wilderness and other Class I Areas surrounding the GMUG when burning operations take place upwind from these areas. SBEADMR visibility impacts would be temporary and transient compared to reduced visibility due to stationary and mobile sources.

Greenhouse Gases

Implementation of Alternative 2 would produce average annual GHG emissions from prescribed burning of about 0.06-0.12% the amount of estimated GHG that will be produced in Colorado in 2020, and 0.0015-0.0029% of estimated GHG emissions estimated to have been produced in the U.S. in 2012 (Table 31). Overall, as spruce and aspen stands die and decay they would produce an unknown amount of GHG emissions that, over time, would be offset by an unknown amount of sequestration from forest regeneration, and to a lesser amount if forest stands are replaced by grass and shrubs. The timber harvest of mostly dead or dying and, to a lesser extent, live spruce and aspen trees, would provide a supply of harvested wood products that would sequester carbon when the harvested wood products (HWPs) are used in construction or the manufacture of durable goods. The net effects of SBEADMR on greenhouse gases, given carbon sequestration from forest regeneration and vegetation growth, is unknown.

Table 31. Alternative 2 Comparisons of Estimated GHG Emissions from Several Sources. In Table 31, the SBEADMR annual average represents the estimated total annual project GHG emissions from prescribed burning.

GHG Emissions Source	Estimated GHG Emissions (millions metric tons)
2012 United States	6,526
2020 Colorado	148
SBEADMR Average Annual	0.10-0.19 (CO_2 and CH_4 combined)

National Ambient Air Quality Standards (NAAQS)

Prescribed burning would be controlled by the CDPHE and it is unlikely smoke impacts to people in smoke sensitive areas would exceed particulate NAAQS because fire managers are required by law to follow smoke permit stipulations. Most smoke impacts occur during night

time and early morning hours when smoke pools in drainages and low lying areas such as valleys where most people occupy homes. People living in smoke sensitive areas will most likely smell smoke at night and during early morning hours.

Smoke Sensitive Areas

The 2007 LRMP identifies the following as smoke sensitive areas: I-70 Interstate corridor; the North Fork, Uncompahgre and the Gunnison River Valleys; and the towns of Grand Junction, Delta, Cedaredge, Paonia, Hotchkiss, Olathe, Montrose, Ridgeway, Ouray, Telluride, Norwood, Nucla, Naturita, Paradox, Gunnison and Crested Butte. Fire managers would be required to identify these areas in smoke permit applications and show how people living in these areas would be notified about prescribed burning well in advance of burning operations. Fire managers would also need to identify how they would monitor for possible smoke impacts and would be required to provide smoke contingency plans in case conditions are forecasted to deteriorate in smoke sensitive areas. CDPHE Regulation 9 requires fire managers to use the Pile Standard Permit Condition Worksheet as a guideline. Smoke dispersal requirements increase as the amounts of slash pile materials increase and as burning operations occur closer to homes.

Alternative 3 (Public Safety Focus) – Direct and Indirect Effects

Direct and indirect effects would be very similar to or the same as Alternative 2 except that all prescribed burning would occur in the WUI and/or in road corridors.

In Alternative 3, 1,100,000 CCF are estimated to be harvested over the life of the project and, based on that total harvest estimate, equipment emissions estimates were made using equipment daily production rates shown in

Table 32. Equipment emissions would be greater compared to Alternative 2 and less than in Alternative 4. Table 33 shows the total amount of logging equipment NAAQS and GHG emissions that would be produced in Alternative 3.

Table 32. Logging Equipment Types, Daily Production Rates, Equipment Horse Power and the Total Numbers of Operating Days Required to Completed Logging Operations Proposed in Alternative 2.

Equipment Type	Daily Production Rate	Horse Power	Alternative 3 Operating Days
Grapple Skidder	300 CCF/Day	175	3,667
Feller Buncher	367 CCF/Day	300	2,997
Stroke Delimber	200 CCF/Day	300	5,500
Loader	200 CCF/Day	175	5,500
Masticator	5 acres/Day	300	1,000
Chainsaw	100 CCF/Day	11	11,000
Pick-Up Truck	100 CCF/Day	N/A	11,000
Log Hauling Truck	10 CCF/Truck	N/A	55,000

Table 33. Total Amount of Logging Equipment NAAQS and GHG Emissions that would be Produced in Alternative 3 (tons)

PM10	PM2.5	CO	C02 (GHG)	CH4 (GHG)	NMHC	NOx	SO2
1.01	0.94	84.15	273.05	0.23	3.82	1.88	0.0025

Alternative 4 (Spruce Salvage) – Direct and Indirect Effects

Approximately 12,600-18,900 acres of spruce resiliency treatments would not take place under Alternative 4 compared to the other action alternatives and a corresponding 88,200-132,300 medium-size slash piles generated during resiliency activities would not be produced. The amount of proposed acres to be treated remains constant within all action alternatives, so spruce recovery treatment acres would increase to make up for the exclusion of spruce resiliency treatments. The number of medium size slash piles generated from recovery activities would increase from 42,000-58,000. Because aspen treatments would be unchanged from Alternatives 2 and 3, the estimates from prescribed broadcast burn treatments would be the same (

Table 27).

In Alternative 4, 1,200,000 CCF are estimated to be harvested over the life of the project and, based on that total harvest estimate, equipment emissions estimates were made using equipment daily production rates shown in

Table 32. Equipment emissions would be greater compared to Alternatives 2 and 3. Table 35 shows the total amount of logging equipment NAAQS and GHG emissions that would be produced in Alternative 3.

Table 34. Logging Equipment Types, Daily Production Rates, Equipment Horse Power and the Total Numbers of Operating Days Required to Completed Logging Operations Proposed in Alternative 4.

Equipment Type	Daily Production Rate	Horse Power	Alternative 4 Operating Days
Grapple Skidder	300 CCF/Day	175	4,800
Feller Buncher	367 CCF/Day	300	3,270
Stroke Delimber	200 CCF/Day	300	6,000
Loader	200 CCF/Day	175	6,000
Masticator	5 acres/Day	300	1,000
Chainsaw	100 CCF/Day	11	12,000
Pick-Up Truck	100 CCF/Day	N/A	12,000
Log Hauling Truck	10 CCF/Truck	N/A	60,000

Table 35. Total Amount of Logging Equipment NAAQS and GHG Emissions that would be Produced in Alternative 3 (Tons).

PM10	PM2.5	CO	C02 (GHG)	CH4 (GHG)	NMHC	NOx	SO2
1.10	1.03	91.92	302.20	0.31	4..16	2.07	0.0027

Table 36. Alternative 4 Estimated Range of Total NAAQS and GHG Emissions from Prescribed Burning of Small Slash Pile for the SBEADMR Project (Tons).

Treatment Scenario and Numbers of Small Slash Piles	SBEADMR Slash Piles Emissions Range - Tons						
	PM	PM_{10}	$PM_{2.5}$	CO	CO_2 (GHG)	CH_4 (GHG)	NMHC
Spruce Recovery Medium Size Machine Pile 10 ft. high, 400 sq. ft. area 5 piles per acre 180,000-270,000 piles total	10,656-15,984	7,902-11,853	6,714-10,071	30,006-45,009	1,313,838-1,970,757	2,214-3,321	1,782-2,673
Non-commercial mechanical, hand treatments Small Hand Piles 6 ft. high, 100 sq. ft. area 7-20 piles per acre 70,000-200,000 piles total	364-1,040	259-740	224-640	1,260-3,600	55,300-158,000	91-260	70-200
Total	11,020-17,024	8,161-12,593	6,938-10,711	31,266-48,609	1,369,138-2,128,757	2,305-3,581	1,852-2,873

Table 37. Alternative 4 Estimated Total Emissions from Prescribed Burning in the SBEADMR Project (Tons).

NAAQS Criteria Pollutant and Green House Gas (GHG)	Treatment Type			
	Slash Pile Burning Minimum / Maximum Emissions (tons)	Aspen Broadcast BurningMinimum / Maximum Emissions (tons)	Logging Equipment Emissions (tons)	Grand Total all Emissions - Minimum / Maximum Emissions (tons)
PM	11,020-17,024	N/A	N/A	11,020-17,024 (1)
PM_{10}	8,161-12,593	800-14,500	1.10	8,962-27,074
$PM_{2.5}$	6,938-10,711	600-12,000	1.03	7,539-22,712
CO	31,266-48,609	7,400-161,000	91.92	38,757-209,700
CO_2 (GHG)	1,369,138-2,128,757	57,800-461,000	302.20	1,427,241-2,590,059
CH_4 (GHG)	2,305-3,581	400-7,000	0.31 (3)	2,706-10,582
NMHC	1,852-2,873	N/A	4.16 (3)	1,860-2,881 (1)
NOx	N/A (2)	60-500	2.07	63-503 (2)
SO_2	N/A (2)	40-500	0.0027	40-500 (2)

(1) FOFEM outputs for aspen broadcast burning do not include PM and NHMC. (2) Piled Fuels Biomass and Emissions Calculator outputs do not include NOx and SO2. (3) Emission factors available for only, and corresponding emissions estimates, Pick-up and Log Hauling Trucks.

Compared to the Colorado emissions inventory, implementation of Alternative 4 would produce an average of about 58-174% percent of historic statewide annual prescribed burning PM_{10} emissions, or 0.8-2% of total statewide annual inventoried PM10 emissions.

The indirect effects relating to Class I Areas, NAAQS, Smoke Sensitive Areas and GHG Sequestration would be very similar to, or the same as Alternatives 2 and 3.

Greenhouse Gases (GHG)

Alternative 4 average annual GHG emissions would be about 0.89-1.70% the amount of estimated GHG estimated to be produced in Colorado in 2020, and 0.020-0.038% of GHG emissions estimated to have been produced in the U.S. in 2012 (Table 38).

Table 38. Alternative 4 Comparisons of Estimated GHG Emissions from Several Sources (Millions Metric Tons).

GHG Emissions Source	Estimated GHG Emissions (millions metric tons)
2012 United States	6,526
2020 Colorado	148
SBEADMR Average Annual[1]	1.32-2.53 (CO_2 and CH_4 combined)
[1]The SBEADMR annual average represents the estimated total annual project GHG emissions from prescribed burning	

Cumulative Effects Common to All Action Alternatives

As under the No Action analysis, effects of past actions on air quality are reflected in the environmental baseline. Going forward, ongoing and reasonably foreseeable impacts to air quality from SBEADMR and other activities, including other prescribed burns and fossil fuel use on the Forest System lands and in the vicinity, would result in higher emissions than those disclosed in the direct and indirect effects. However, the capacity of the Forest Service to complete significantly more prescribed burns than those identified in SBEADMR is unlikely; cumulative emissions from these activities are likely within the range disclosed in the direct and indirect effects analysis.

Carbon

From the emissions that can be quantified pertinent to SBEADMR, implementation of Alternative 2 could produce average annual greenhouse gas emissions of about .06-.12% of those

estimated to be produced in Colorado in 2020; these figures would be higher in combination with ongoing and reasonably foreseeable actions in the project area. However, as noted above, treatment-related emissions from prescribed burns and equipment would not likely be significantly higher than those disclosed in SBEADMR, as the capacity of the Forest Service to complete such additional treatments would be limited.

However, the cumulative net effects of SBEADMR and these other activities on carbon storage/greenhouse gas emissions, relative to the No Action Alternative, are difficult to quantify. As noted above, to the extent that impacted soils in treated areas may act as a source, harvested wood products and higher rates of regrowth in planted areas (and those with more open canopies) would also serve as carbon sinks.

Fire and Fuels

Compliance with Regulatory Direction

Forest Service direction guiding this project includes the Forest Service Manual (FSM) 5100. According to Forest Service Manual (FSM) 5100, Chapter 5150, and corresponding R2 Supplement No. 5100-93-2, methods used for controlling flammability and reducing resistance to control may include mechanical, chemical, biological, or manual means, including the use of prescribed fire. The supplement adds details pertinent to fuels management in R2, in particular, the maintenance of fuel profiles consistent with historic fire regimes characteristic of sustainable ecosystems and/or consistent with land uses. Policies pertinent to prescribed burning and state air quality regulations are included in Forest Service Manual (FSM) 5100.

The proposed project also adheres to the 1991 Forest Plan Amendment for fuel treatment activities in management areas 1A (Developed Recreation Sites), 1B (Downhill skiing and winter sports) and 1D (Utility corridors and electronic sites), to “maintain fuel conditions which permit fire suppression forces to meet fire protection objectives for the area,” following the standard and guideline to “Reduce or otherwise treat all fuels so the potential fireline intensity will not exceed 100 BTU’s/sec/ft (B138) on 90% of the days during the regular fire season” (8224GM). This threshold correlates to 4-foot flame lengths. The GMUG will comply with this standard and guide by treating fuels to keep flame heights of potential wildfires under 4 feet in management areas 1A, 1B an 1D.[6]

[6] When making fire suppression tactical decisions near values at risk or in the wildland urban interface (WUI), firefighters base their decisions in part on anticipated flame length. The Hauling Chart is a tool that helps firefighters calculate the probable flame length and, with flame lengths over 4-foot, the chart also recommends using heavy equipment instead of firefighters on foot.

Analysis Methodology

Due to a lack of quantitative data on surface and canopy fuels and inherent error in fire behavior modeling, effects analysis will largely be discussed in a qualitative manner, with some quantitative examples. Note that the quantitative fire behavior examples are only for surface fire. Crown fire was not modeled because several assumptions would have to be made, and crown fire transition models are sensitive and not always very accurate.

Some background data were used in a fire behavior model to exemplify situations bounding expected effects. The last ten years of weather data were obtained from the Lujan RAWS (Remote Automated Weather Station) and McClure Pass RAWS, stations which typify weather on a large portion of the Engelmann spruce on the GMUG. Using weather data typical of the June 1 through October 31 fire season, fuel models representing various fuel conditions were run through a fire behavior modelling application, BehavePlus 5.0.5, to predict flame height for typical areas. BehavePlus is a fire behavior modelling application which calculates estimates of fire behavior characteristics such as flame height or rate of spread given inputs such as fuel model, fuel moistures, slope, temperature, relative humidity and wind. Predictions were run for 0 and 30% slope to bracket most mechanical treatment conditions. For fuel models with a live woody component in the surface fuels such as shrubs or young trees, 60% fuel moisture was used to simulate dry, late season conditions (Vaillant et al. 2009).

Potential surface fire behavior specific to this project was estimated for situations where Forest Plan Standard and Guidelines require flame heights lower than 4 feet to allow fires to be more readily suppressed – management areas 1A, 1B and 1C. Extensive modeling was not done for all fuel types due to the limitations in the methods. Potential fire behavior was also estimated for a sample vegetation type where fuel reduction may not have occurred, such as over-mature or dead spruce, for comparison. Potential fire behavior was also estimated for scenarios in which grass, forbs and shrubs grow back after trees die and fall or are removed through treatments and more sunlight is available at the forest floor.

In order to understand the contribution of past actions to the cumulative effects of the proposed action and alternatives, this analysis relies on current environmental conditions, or the aggregate of effects of past actions (CEQ, 2005).

Affected Environment

Climate

Climate, not fuels, may be the most important factor in driving fire extent in subalpine areas of the Rocky Mountains, such as the opportunity area for this project (Sibold et al. 2006). The project area experiences cold winters and hot, dry weather generally early in the summer, followed by monsoons later in the summer. Figures 26 through 29 show high summer

temperatures between June and September. The Energy Release Component (ERC), which is a measure of how hot a fire could burn, is high early in the summer, and then drops slightly in July as the summer monsoon generally begins and fuel moistures are higher. During extreme weather conditions, which are becoming increasingly common (Sherriff et al. 2014), fires in spruce-fir burn with high intensity and are generally not affected by control efforts until winds slow down and cooler, moister conditions prevail. In the SBEADMR project area, both winter and summer temperatures have increased in recent years. As discussed previously in this EIS, recent weather data indicate that the past decade has been the hottest and driest in centuries (Worrall et al. 2013, Worrall and Rehfeldt 2014).

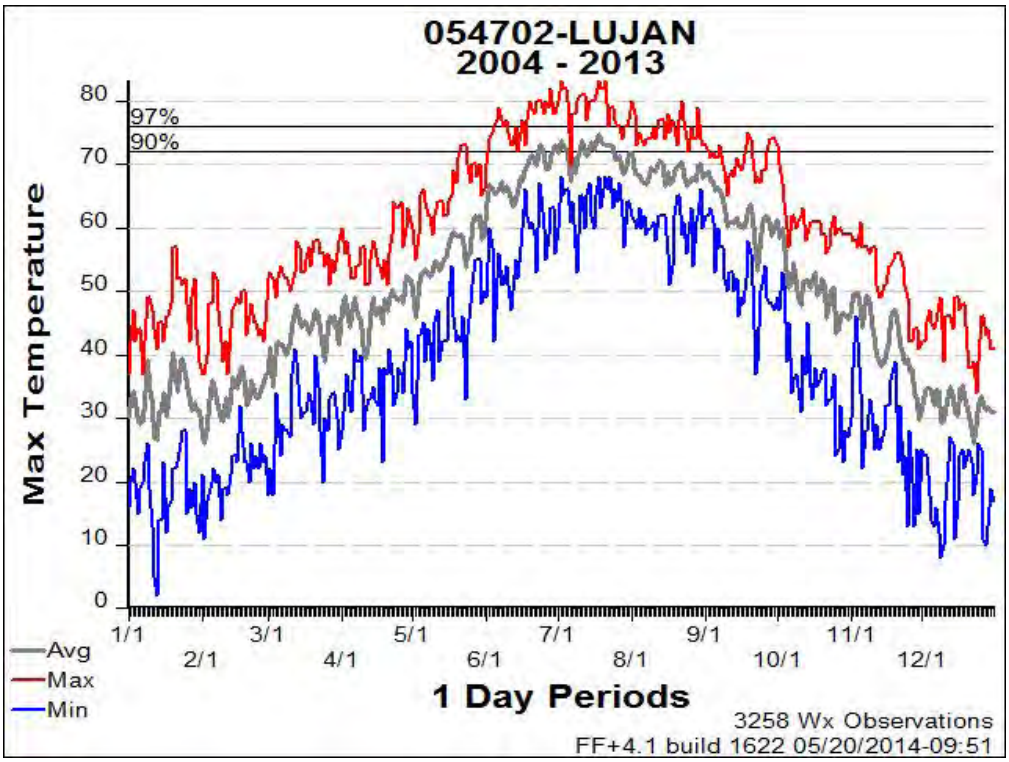


Figure 26. Maximum daily temperatures for the past ten years for Lujan RAWS.

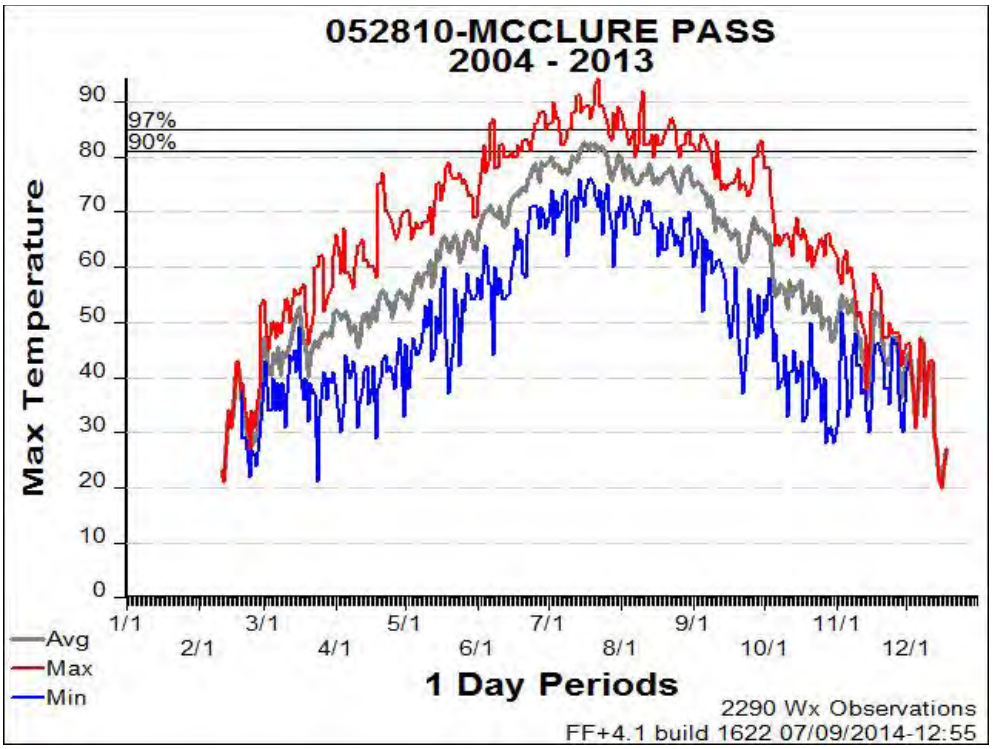


Figure 27. Maximum daily temperatures for the past ten years for McClure Pass RAWS.

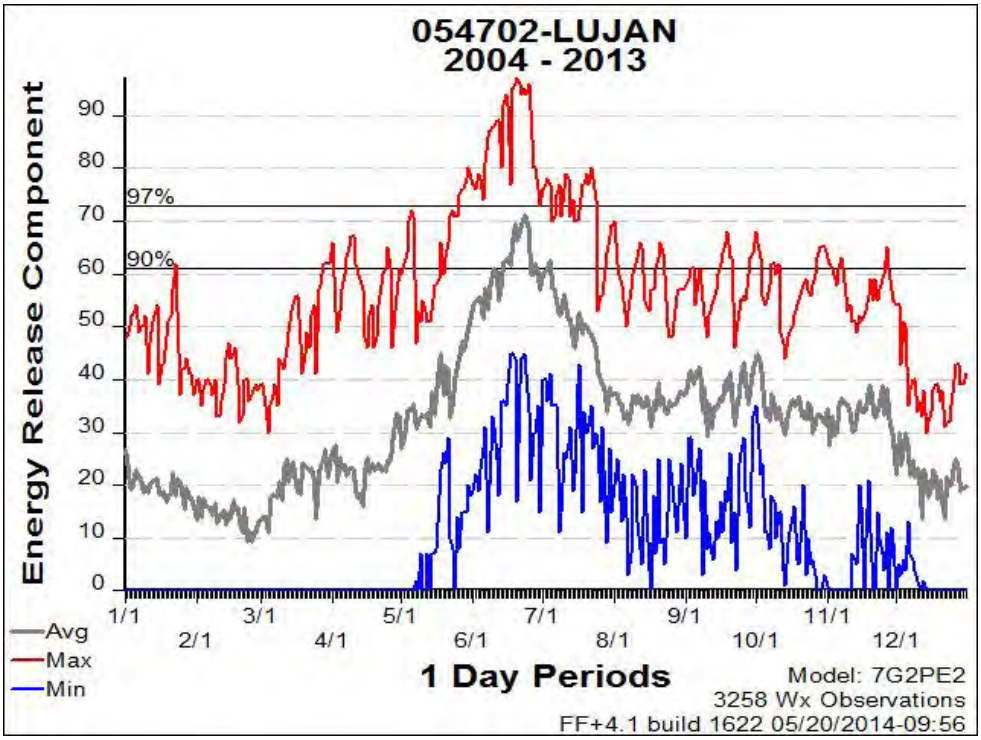


Figure 28. Energy Release Components for the past 10 years for Lujan RAWS.

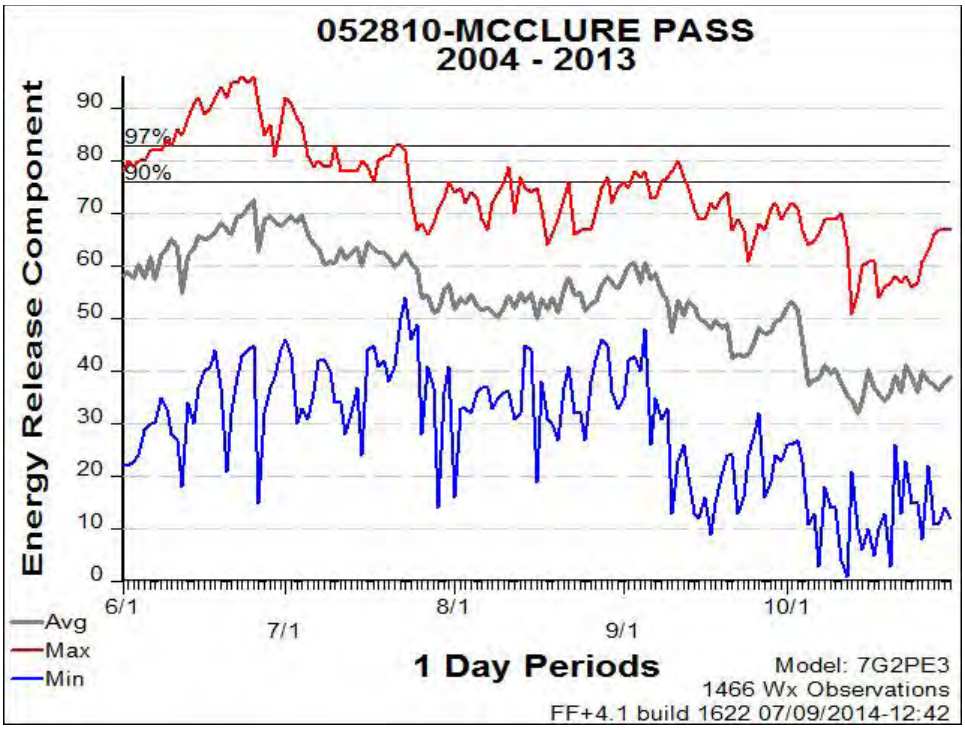


Figure 29. Energy Release Components for the past 10 years for McClure Pass RAWS.

Fire Regimes

Spruce

Fire regimes in spruce-fir are generally categorized as Fire Regime V, or infrequent fire occurrence (200+ years) that result in stand-replacing fires; fires could be up to 500 years apart in higher elevations (USDA Forest Service 2007 Fire Use Forest Plan Amendment, Appendix E). About 60% of spruce/fir stands on the GMUG are overmature (Forest Plan, 1991). Due to the overmature nature of many of these stands (stand density, ladder fuels in the form of regeneration, and build-up of surface fuels) it is expected that many of these stands would readily support fire under dry, windy weather conditions. Although most ignitions in spruce-fir lead to fires which are generally small, slow-moving, and exhibiting less than 2-foot flame lengths, under extreme weather conditions, fires in spruce-fir stands become stand-replacing, plume-dominated fires exhibiting high-intensity crown fire, long range spotting, significant rates of spread and high-severity fire effects.

As noted above, there is some consensus that "fire regimes in the subalpine zone of the Rocky Mountain region are driven primarily by fire weather" (Sibold et al. 2006). That being said, fuels must still be present in an amount and configuration that supports fire establishment on the landscape when weather is conducive for fires to occur. Current stand conditions in spruce across much of the GMUG are adequate to support significant fire intensity and fire size, or are

approaching those stand conditions due to age and successional processes. Unlike other more mesic ecotypes which have experienced a fuels buildup since fire suppression activities began to exert influence in the 1900's, fire regimes in spruce have not been affected as much as those in lower elevation, more mesic vegetation types (Sibold et al. 2006). However, comparisons of historic photos to present conditions do suggest changes in stand condition that would lead to higher severity fires. Stands were more open, with much more diversity of sizes and ages; small openings were much more frequent. On a multi-stand or landscape scale in spruce/fir, there is more continuity of older age classes, or juxtaposition of older age classes against other older age classes, due to a decrease in fire disturbance on the landscape over the past one hundred plus years. This condition of increasing continuity of older age classes in spruce/fir is not as significant as found in more mesic forest types at lower elevations but is beginning to manifest itself in the widespread nature of the current beetle outbreak and could well manifest itself in future years as very large fires such as occurred on the Rio Grande National Forest in 2013 (see 'Historic Fires' discussion below).

Aspen

Fire in aspen is not well understood. Due to lush herbaceous and understory growth and moist conditions, fire generally does not burn through pure aspen stands. Fire may be carried through stands of aspen mixed with other conifer if enough needles are present in the surface fuels. When aspen is present in a stand of more flammable species, it can sprout prolifically after fire. Because aspen is found mixed with many other vegetation types, it is difficult to place in any particular fire regime. When aspen is found with vegetation types which burn in low-severity, frequent fires, aspen may regenerate post-burns enough to remain a part of the vegetation type. As fire regimes increase in severity or size, seral aspen, or aspen which is eventually replaced by other tree species, may tend to increase. In high-severity fire regimes where fires are infrequent, such as the fire regime in spruce, aspen may regenerate initially after fire, but may eventually be replaced by other tree species (Shinneman et al. 2013).

Historic Fires

Stand-replacing fire frequency in presettlement spruce-fir forests ranged from 300 to 400 years; most stand-replacing fires were a few hundred to a few thousand acres. Small fires occurred approximately every decade per 2500 acres.

Historic fires on the GMUG demonstrate that most fires do tend to remain small and infrequent in the subalpine zone, but during extreme fire weather, fires can grow large, as demonstrated by the 2013 West Fork Complex of fires on the adjacent San Juan and Rio Grande National Forests. Three relatively recent fires in spruce/fir and aspen are indicative of fire behavior and fire size on the GMUG. Each of these fires burned during drier fire seasons but under non-extreme weather condition; if local weather, particularly winds, had been more extreme significantly more fire

growth would likely have occurred. The Beaver Fire in July, 2002 burned 344 acres of north facing spruce/fir with a significant aspen component. The resistance to control on this fire was significant due to heavy surface fuel loadings, patchy and spotty burn patterns, and snag patches; as a result this fire was transitioned to a Type 2 Incident Management Team. The Alta Fire in July, 2005 burned 120 acres of spruce/fir and patches of aspen in the Wildland Urban Interface near Telluride. Containment and control of this fire took several days and required heavy equipment and significant aerial resources. The East Fork Fire in June, 2013 burned approximately 447 acres in spruce/fir and patches of aspen near Wildland Urban Interface in the Cimarron Creek drainages. The East Fork Fire required heavy use of aerial resources to protect structures and was transitioned to a Type 2 Incident Management Team due primarily to resistance to control issues caused by heavy surface fuel loadings and extremely high elevations. Between 2003 and 2012, 43 fires burned approximately 24,000 acres on the GMUG. The median fire size for these years was 171 acres and 25% of the fires which burned during this period were 41 acres or smaller. For the period between 1993 and 2002, 32 fires burned a total of 39,000 acres. The majority of these fires (21) burned during the fire seasons of 1996 and 2002.

The West Fork Complex started June 20, 2013 on the Rio Grande National Forest and was composed of three fires, the West Fork, Papoose and Windy Pass, which burned 110,000 acres, the second largest area burned by any fire in Colorado since 1910. Water-repellent soils were estimated to cover about 21,000 acres as a result of the West Fork and Papoose fires (USDA Forest Service 2013a,West Fork BAER Report). The West Fork and Papoose fires burned in spruce-fir, a majority of which was beetle-killed and in the “dead and grey” stage. Fire behavior was often labeled “extreme.“ Recent science indicates that the presence of spruce beetle kill alone does not influence subsequent fire severity (Berg and Anderson, 2006; Kulakowski and Veblen 2007), though such research indicates that stand conditions play a large role. Whether due to pre-beetle stand conditions or the beetle epidemic or both, when combined with the extreme weather conditions, the West Fork and Papoose stand-replacing fires were more than 2 orders of magnitude larger than pre-settlement fires.

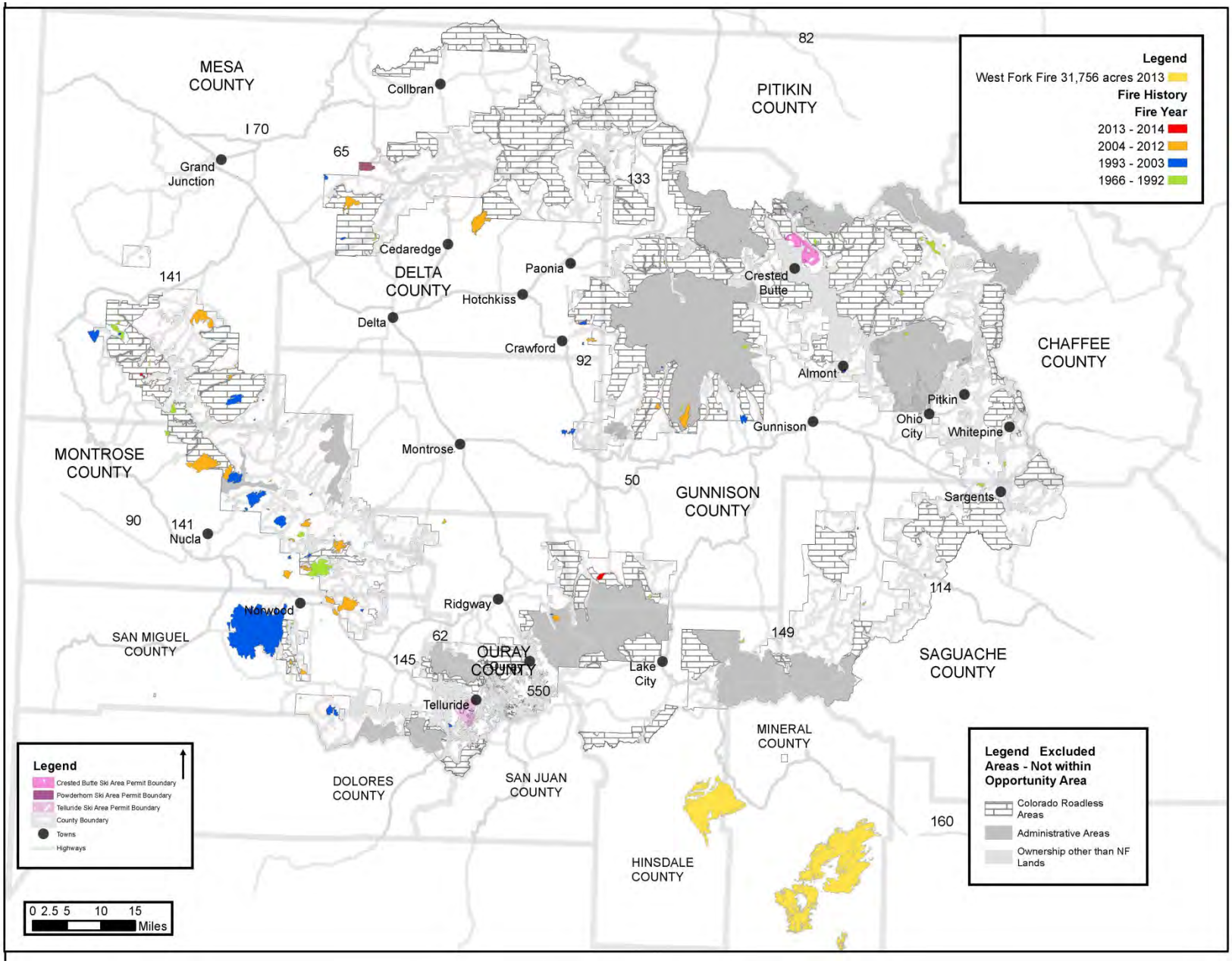


Figure 30. Fire history of the GMUG

Fuel Loads

Several characteristics associated with fuel loading affect fire behavior; these include the total weight of fuels in an area and the size and the arrangement of the fuels. Surface fuels, such as fallen branches, are classified into categories called timelag classes based on their diameter and the time it takes them to reach 2/3's of the way to equilibrium with the moisture in the local environment. The timelag fuel categories are <1/4" (a blade of grass or small twig); ¼-1" (a small fallen branch); 1-3" (a medium fallen branch) and >3" (a log or large branch) in diameter, called 1-hour, 10-hour, 100-hour and 1000-hour fuels, respectively. Canopy fuel loads are those fuels in the canopies of trees. Smaller diameter fuels ignite and burn more rapidly, whereas larger diameter fuels may not ignite as fast, but burn longer. Fuel models are numeric representations of different fuel situations based on loading of fuels by timelag category, fuel bed depth and other fuel characteristics. Fuel models can be used to generate potential fire behavior using fire behavior modelling applications.

Although total fuel loadings are influenced greatly by the amount of 1000-hour fuels, fire *behavior* often depends more highly on the amount and arrangement of smaller fuel classes. The 1, 10 and 100-hour fuel loadings may not make up the majority of the fuel loading on a site, but they may drive the rate of spread and flame length of the fire more so than 1000-hour fuels. The 1000-hour fuels can burn for long periods of time and transmit heat to soils and plants, and so are more important than the smaller fuels in predicting fire *effect*s.

Spruce

Fuel loadings and the associated potential fire behavior in beetle-affected stands depend on the vegetation type, age class structure, the stage of or time since beetle attack, and management activities. In Engelmann spruce stands, which are often mixed with subalpine fir (*Abies lasiocarpa*), other conifer species or aspen, surface loadings of 1000-hour fuels are generally less than 20 tons/acre (Jenkins et al. 2008), and total fuel loadings usually range from 9 to 20 tons/acre (USDA Forest Service 2011).

In stands experiencing epidemic levels of spruce beetles, 1000-hour fuel loadings can be approximately 30 tons/acre. Within 20 years after the beetle epidemic, 1000-hour fuels can increase to 50 tons/acre as dead trees fall, and may not drop below 40 tons/acre for a century (Jenkins et al. 2008).

Aspen

Aspen stands generally only burn well under very dry conditions and when other plants or trees provide dry surface fuels, such as grass, brush, or conifer needles. Depending on the age, mortality and structure of the stand, total downed woody loadings could be anywhere from 3

tons/acres in recently regenerated stands to 20-35 tons per acre in stands where significant numbers of dead trees have fallen (USDA Forest Service, Digital Photo Series).

Table 39. Fuel Scenarios, Fuel Models Assigned and Fuel Characteristics.

Note that these fuel models were chosen to represent only surface fuels, not canopy fuels associated with standing trees. All values in the 1 hour and fuel bed depth columns are standard values associated with assigned fuel models (Scott and Burgan 2005) unless otherwise noted. Fuel characteristic values for fuels models in parenthesis are also in parenthesis)

Fuel Scenario	Representative fuel models	1-hr fuels t/a	Fuel bed depth ft	Total surface dead woody fuel loads
Aspen, pure stands, or stands mixed with some conifer	Western Aspen (low-forb)	0.035[1]	0.18	Not available
Spruce-fir stands without significant disease, windthrow and not overmature	TL3	0.5	0.3	7[4]
Over mature, live Spruce-fir, the most common stand and fuel scenario in spruce/fir on the GMUG	TL5	1.15	0.6 or 1-2[2]	9[2] to 20[2,3] and up to 70[3]
Spruce-fir dead 2-20 years, no treatment	SB2[6]	4.5	1	Generally 50[4, 5] and up to 95[4,5]
Salvage logged spruce-fir; no surface fuel reduction	SB2	4.5	1 or 1-2[2]	35-40[3] or generally 50[5] and up to 95[5]
Salvage logged spruce-fir; surface fuels reduced to meet forest plan guidelines guidelines in management areas 1A, 1B and 1D	TL3[7]	0.5	0.3	10 or less
Salvage logged spruce/fir or aspen about 10 years post-treatment with grass and shrub regrowth	GS2	0.5	1.5	Not available
	SH6	2.9	2	Not available

[1]10-hour fuels used for aspen, 1-hour not available
[2]Grand Valley EA (USDA Forest Service 2011)
[3]La Garita EA (USDA Forest Service 2013)
[4]Jenkins et al. 2008
[5]Cahill et al. 1951
[6]Note that in dead or dying spruce with needles and fine branches still intact, crown fire potential is high and is not captured by fuel model SB2, which is meant for modeling surface fire.
[7]A TL3 fuel model which is 'moderate load conifer litter' is used to exemplify surface fuel loading and surface fire behavior despite the fact that this fuel model has standing trees in it whereas an area that is salvage logged would not. Any crown fire modeled with this fuel model would not apply.

Potential Fire Behavior

In general, embers produced by torching and active crown fire can be lofted up to several miles ahead of afire, allowing the fire to "skip" across the landscape, yielding much higher rates of spread. Large quantities of embers can ignite many spot fires ahead of the main fire front, and

can lead to mass ignition, where a large area ignites at once, fueling large fire growth (Charles McHugh, pers. comm.). Torching is when individual tree canopies or small groups of trees ignite from heat produced by burning surface fuels. Active crown fire is a fire which presents a solid wall of flame in both surface and tree crown fuels.

Spruce-Beetle Affected Stands

There are seeming conflicts in the literature about the effect of bark beetle outbreaks on fire behavior (Jenkins et al. 2008; Pollet and Omi 2002; Hart et al. 2015). Sibold (pers. comm.) found that across the Rocky Mountains as a whole, beetle outbreaks in lodgepole and spruce did not correlate to increased fire occurrence/frequency. Some studies on the relation between spruce beetle outbreaks and fire activity showed no increase in fire severity or extent (Berg and Anderson, 2006; Kulakowski and Veblen 2007). However, Kulakowski and Veblen did find that the age of the stand did affect fire, with young stands burning less severely; they also found that blowdown was the most important variable in determining fire severity.

The character of potential fire behavior changes with time since the inception of beetle infestation. While trees are being infested, but still appear green, they will have lower foliar moistures (Page et al. 2014), enabling ember production, torching, and crown fire to more easily occur.

As needles dry and turn “red,” there can be a higher potential for active crown fire and torching due to much lower foliar moistures and more flammable foliar chemistry (Hicke et al. 2012, Perrakis et al. 2014, Page et al. 2014).

Once trees lose needles (grey phase), and when they begin to shed smaller branches and fall, a threshold can be crossed where there is no longer enough fuels in the canopy to support crown fire. The potential for crown fire may be reduced in stands with high amounts of beetle mortality for 1 to 2 decades after attack due to a reduction in the fine fuels which make up the canopy (DeRose and Long 2009). However, in recently dead, grey-phase spruce, many fine branches still exist which can support torching, as well as lichens and loose bark which are some of the materials most likely to be lofted as burning embers, responsible for fires spreading quickly through spotting (Charles McHugh, pers. comm.). As fuels which were once in trees are transferred to the forest floor, surface fire properties and torching potentials increase (Hicke et al. 2012, Jenkins et al. 2014). Additionally, without a significant canopy shade and shelter the forest floor from the sun and wind, understory herbaceous plants, grasses and shrubs may increase, and the additional sun and wind may dry fuels, increasing surface fire rates of spread and flame lengths.

Table 40. Surface Fire Behavior Characteristics in Sample Fuel Types Given 90th Percentile Weather.

Note that these fire behavior characteristics do not account for crown fire behavior. The first set of values for flame length and rate of spread were generated using 90th percentile weather from Lujan RAWS and the second set were generated using 90th percentile weather from McClure Pass RAWS. Estimated using BehavePlus 5.0.5.

Fuel Scenario	Representative fuel models	Slope %	Surface flame length (feet)	Surface rate of spread (chains per hour)
Aspen, pure stands, or stands mixed with some conifer	Western Aspen (low-forb)	0	1.7/1.8	3.6/4.2
			1.8/1.9	3.9/4.5
Spruce-fir stands without significant disease, windthrow and not overmature	TL3	0	1.7/1.8	4.1/4.8
		30	1.8/1.9	4.5/5.1
Over mature, live Spruce-fir, the most common stand and fuel scenario in spruce/fir on the GMUG	TL5	0	3.5/3.7	11.2/13.5
		30	3.6/3.9	12.1/14
Sprucedead 2-20 years with no treatment or spruce after salvage logging with no fuels reduction.	SB2	0	10.2/11	39.6/46.8
		30	10.5/11.3	42.7/49.9
Salvage logged spruce, after fuels reduced enough to meet forest plan guidelines in management areas 1A, 1B and 1D	TL3	0	1.7/1.8	4.1/4.8
		30	1.8/1.9	4.5/5.1
Salvage logged spruce/fir or aspen about 10 years post-treatment with regrowth – shorter grass/forb	GS2	0	1.2/1.5	5.4/5.4
		30	1.5/1.5	5.4/5.4
Salvage logged spruce/fir or aspen about 10 years post-treatment with regrowth – taller grass/forb/brush	SH6	0	10.7/11.4	30.3/34.5
		30	11.4/11.7	34.5/36.8

Despite the conflicts in the literature about the effect of bark beetle outbreaks on fire behavior, it is possible that post-epidemic stands, which have lower crown fuels but higher surface fuels, may have higher rates of spread due to spotting, higher fireline intensities due to large-size fuels and large amounts of dead fuel, and will create greater soil heating. Fire behavior modelling applications used to predict potential fire behavior in beetle-affected stands have produced contradictory results. However, field observations during fires suggest these stands experience increased probabilities of torching, crowning and spotting.

Fire Suppression in Spruce-Beetle Affected Stands

Regardless of changes in potential fire behavior, fire suppression activities in beetle-killed stands may be hampered by the presence of many snags, higher numbers of fallen trees and branches on the forest floor (Cahill 1951, Jenkins et al. 2013) and increased localized fire intensity due to these larger fuels. Standing or fallen dead material may provide a receptive and susceptible fuelbed for fire spread through spotting. Additionally, falling snags and live trees weakened by

fire are very hazardous to fire suppression personnel, and clearing fire areas of dangerous snags takes additional effort and time. Clearing fireline through heavy downed logs requires more effort and time than fireline construction without these obstacles. Building direct fireline adjacent to fires burning intensely due to large, downed fuels is not particularly feasible. For these reasons, suppression efforts are hampered and may become unsafe for fire personnel to proceed with line construction efforts. Logs and heavy down fuels burn longer than surface fires in lighter fuels, requiring prolonged fire suppression efforts long after the main flaming front has passed (Hicke et al. 2012).

Aspen

Fire behavior characteristics in aspen are generally much lower than that of spruce. Due to lush herbaceous and understory growth and moist conditions, fire generally does not burn through pure aspen stands. Fire may burn through aspen stands with other conifer species by consuming the needles cast by the conifers. Surface fires may also burn in aspen with a cured grass, down woody material (sticks), or shrub component. Most often wildfires will slow and may even stop upon burning into an aspen stand.

Effects of Fires

Fire effects vary not only by vegetation type, which influences fuels, but also by the topography and the particular weather which precedes and occurs during the fire. In spruce, fire are generally small during average fire seasons and associated effects are low. During drier years, live spruce fir mortality from wildfires can be 75-90%. Fire effects in aspen depend on the vegetation type in which it is found. In aspen-dominated stands, in which fire can be carried by the cured understory plants, pockets of aspen may be killed and resprout. In stands with a minor aspen component, which have largely succeeded to spruce-fir, fire may burn intensely through the conifer component, and aspen will sprout from roots protected by soil (USDA Forest Service Fire Use Forest Plan Amendment, Appendix E, 2007).

There is very little research on the effects of fires on soils in beetle-affected stand conditions. Below-ground ecosystem structure, functioning and processes are impacted by the amount of soil heating, including formation of a hydrophobic layer, or a layer which repels water. The maximum soil temperatures in forest fires are generally 200-300 degrees C, but can be as high as 400 under slash. Typically, soil heating may only travel about 5 cm deep in soil, but under high accumulations of slash, temperatures may reach 250 C at 10 cm down, and can exceed 100 C as far as 22 cm below the surface (Neary et al. 1999). After the West Fork fire, 40% of the area classified as high and moderate severity was found to have water repellency (West Fork BAER Report). It is assumed that because spruce has coexisted with disturbances due to beetles and fire, these ecosystems would be capable of recovering from fire effects in post-epidemic stands.

However, due to the higher mortality rates in this outbreak of as much as 4 times mortality rates in historic outbreaks, there could be novel and/or unanticipated effects.

Desired Condition

Specific to fire and fuels management on the GMUG, a desired condition is to remove dead snags and reduce the hazard of falling trees in areas so that firefighters can be more effective in managing or suppressing fire on the landscape.

Another desired condition on the GMUG NFs is to create defensible space near infrastructure, WUI areas, and other values at risk on the landscape. Defensible space is the immediate area around a structure or value in which the vegetation has been managed to reduce fire danger, specifically by reducing flame length and fire spread, and increase firefighter safety. Firefighters often will not attempt to protect a value without adequate defensible space, as it is less safe and less likely to succeed. It should be noted that while defensible space enables firefighters to better protect a specific value on the landscape, it typically does not have an impact on managing the overall spread of a fire; in other words, the value may have been protected from the fire but the fire is still actively moving across the landscape.

A third desired condition for the GMUG NFs is to create more locations across the landscape from which firefighters can safely and effectively manage or suppress fires. These locations may be along travel corridors where fuels have been reduced or may be created by linking together fuel reduction treatments and natural barriers across the landscape. These areas are typically more linear in nature and allow firefighters to manage fire growth or control a fire perimeter by establishing anchor points for fireline construction and/or implementing backfiring operations.

These tactics were exemplified on the Wheeler fire in California in 2007 where the fire moved through several linear bands of fuels treatments during the first and second day of growth while fire conditions were extreme and before suppression forces were fully in place. After weather conditions were slightly more suitable, suppression resources used another linear band of fuel treatments on the fire's east side to stop the fire from spreading down into a nearby valley with a major travel corridor and private properties (Fites et al. 2007). The multiple lines of defense enabled more effective wildfire suppression for values at risk.

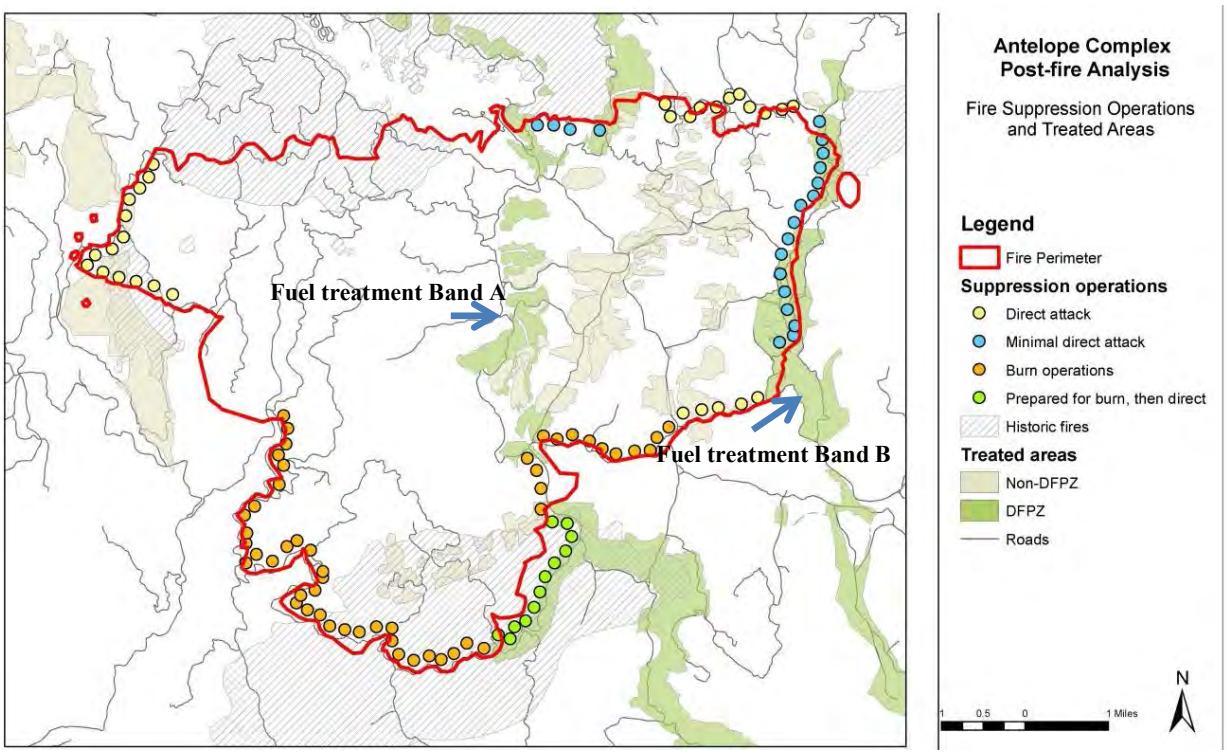


Figure 31. Map illustrating the potential for redundant fuel treatments on the landscape to enhance wildfire management capabilities.

Treated areas within and near the fire perimeter and locations of suppression operations for Antelope Complex, California, 2007 (Fites et al. 2007). In Band A of Figure 31, the fire location, intensity, and rate of spread were such that this area was not usable to control the fire. In Band B, this treatment area was used successfully when suppression resources were available and when fire intensity was lower. Minimal direct attack was needed to control the perimeter due to lower fuel loadings and lower fire intensity. DFPZ is a defensible fuel profile zone.

Fire and Fuels Indicators

Indicators for treatment success relative to fire and fuels desired conditions and objectives include the following: surface fuel loading, ladder fuels, canopy continuity, defensible space, snag density (particularly near values at risk and travel corridors), presence of young aspen stands (particularly near WUI).

Alternative 1 (No Action) – Direct and Indirect Effects

This alternative is used as a basis for comparing the effects of the Proposed Action and other alternatives. It assumes no implementation of the proposed action and the action alternatives. No trees would be harvested and no noncommercial mechanical and prescribed burning treatments would occur, unless authorized by other decisions.

Under Alternative 1, all surface fuels in newly beetle-infected spruce stands would remain untreated and unaltered by silvicultural activities, unless treatments are authorized under separate decisions. If hazard tree removal needs to be authorized under separate decisions, there would be delay in such treatments, such that risks to the public and firefighter safety would remain elevated for a longer period of time. The immediate effects of not using prescribed fire would result in higher surface fuel loadings and less aspen regeneration in comparison to the action alternatives.

Fire Behavior

Under the No Action alternative, no dead or dying trees would be removed. Surface fire behavior in beetle-affected stands may be relatively low initially, until needles, branches and whole trees begin to fall. From the time trees are green-yet-beetle-infested to the time when needles fall, the potential for torching and active crown fire will be higher than in unaffected and/or untreated stands.

Trees killed by bark beetles would begin to weaken and fall over the course of the next several decades. With more dead trees on site over a longer period of time, there would be increased surface fuels as trees fall over time relative to the action alternatives. This would increase the amount of down woody debris in all categories (1-1000 hour). The smaller diameter fuels would increase surface fire rates of spread and flame lengths. As trees die and fall, more sunlight and wind can reach surface fuels and increase drying and therefore fire behavior. The heavy surface fuels would increase the soil burn severity when a wildfire occurs, meaning potential increases in erosion and runoff after wildfires. Yet after needles and branches fall to the ground, canopy fuels will be lower, lowering the potential for crown fire relative to green stands and standing dead and diseased stands.

As SAD continues unchecked, aspen trees would weaken, die and add to surface fuel loadings in aspen and mixed aspen/spruce stands and more sunlight and wind can reach surface fuels and increase drying and therefore fire behavior. The effects of not completing any broadcast burning treatments in aspen would be increased surface fuels in the near term, and decreased rates of stand regeneration compared to the action alternatives. Future wildfires may not slow or extinguish in these stands, relative to treated and/or undiseased stands. Additionally, these aspen stands may convert to either shrub or later-seral species such as spruce, both which have higher potential fire behavior than young aspen stands. Over long periods of time, aspen stands mixed with other species might shift dominance to later-successional species such as spruce, which can burn in high-intensity fires. Under the No Action Alternative, no resiliency treatments would be implemented. Current canopy continuity in green stands would remain, with an abundance of large trees, such that stand conditions would remain ripe for high-intensity, stand-replacing fires that can spread unchecked across the landscape as crown fire. Under more likely extreme

weather in the coming decades, such stand-replacing fires are more likely to be larger in extent than the historic and presettlement wildfires.

At the landscape scale, the effect on wildfire of not implementing recovery and resiliency treatments may be relatively small, largely because of the small percentage (4% of the GMUG) proposed for treatment, and because large fires are generally weather-driven in the project area. However, without treatments in affected and green stands to encourage canopy discontinuity, younger trees, and reduce surface fuels in strategic locations, the ability of land managers to safely defend values at risk and manage wildfire in spruce-fir for resource benefit would be constrained. Full suppression of wildfires would be more likely.

Wildfire Management and Suppression

Additionally, falling trees are a significant hazard for fire suppression operations. Without a reduction in snag hazards from active treatments, fire management resources may need additional time and money to deal with snags during active wildfire management operations. It is possible that fire resources could not engage the fire directly in areas with too high of a snag hazard. Additionally, without treatments, there would be fewer areas which could serve as anchor points or defensible space during wildfires, reducing ability to effectively manage wildfire for resource benefit or to suppress it

Further, without strategic treatments in and near the WUI, firefighters would be less able to safely defend infrastructure, whether in the case of a managed or suppressed wildfire situation.

Alternative 1 (No Action) – Cumulative Effects

There are no proposed management activities under Alternative 1. Therefore, no change to fire or fuels would result from the implementation No Action Alternative. The direct and indirect effects of natural processes in combination with past, ongoing, and future activities could result in cumulative effects to fire and fuels characteristics.

Current and future vegetation management activities authorized by other decisions, as noted in the table below, would result in lower fuels, which would somewhat offset the expected direct effect of increased fuels in Alternative 1.

Present and Future Projects and Activities in the Cumulative Impacts Analysis Area.

Agency	District	Foreseeable Future Project	Impacts within the range of those described in direct and indirect impact (Yes/No) and effects analysis and additional comments.
USDA Forest Service	Gunnison	Cochetopa Hills Vegetation management	Yes
	Grand Valley	Mesa Point Fuels treatments	Yes
	Norwood	Naturita Fuels	Yes
	Grand Valley	Spruce Beetle SAD treatments	Yes
	Grand Valley	Resort Mesa treatments	Yes
	Ouray	Escalante Forest Restoration treatments	Yes
	Gunnison	La Garita salvage treatments	Yes
USDI BLM	Gunnison Field Office	Gunnison Spruce Beetle Response	Yes

Most aspen would remain untreated in the No Action Alternative and lead to increased surface fuel loadings; recent research demonstrates that dead aspen in SAD-affected stands will fall within 16-17 years after death (Shepperd, Smith, and Pelz 2015), so surface fuel loading would increase in the medium and long-term.

In spruce-fir, the relationship between increased fuel loadings (surface, ladder, or canopy) and wildfire is complex. At the landscape-scale, the cumulative effects on wildfire of increased fuels under the No Action may be insignificant, because wildfires in spruce-fir are generally weather-driven. At the site-scale, however, in the medium- and long-term, untreated areas would experience higher surface fuel loading as dead trees fall. With increased surface fuel loading, the likelihood for higher-severity impacts to soil in the event of wildfire is increased; nutrient cycling can be disrupted, water can be repelled, and pioneer species establishment can be reduced in severely burned soils. For wildland firefighters engaging a wildfire to protect values at risk in the wildland urban interface, increased fuel loadings in spruce-fir would lead to more unpredictable, and therefore more hazardous, conditions. As noted in Chapters 1 and 2, the changing climate will be more conducive to more frequent and more extensive wildfires in these higher-elevation forests than we have historically experienced. In the context of increasing population pressures over time and its associated increasing infrastructure at the wildland urban interface, the combination of higher frequency and severity fires attributed to climate change,

increased fuel loadings attributed to spruce beetle, and more standing snags (hazard trees) would likely lead to much more hazardous conditions for wildland firefighters to safely and effectively protect values at risk, let alone attempt to manage such for resource benefit.

In aspen, cumulative effects on wildfire at the landscape-scale in the near-term may be insignificant. Over time, however, SAD-affected stands may be completely lost, and the succession in its stead would likely not be as fire-resistant as are aspen. In the medium and long-term, due to the increased surface fuels and the regrowth of understory vegetation without canopy cover, wildfires and their rate of spread in these areas may be more likely compared to treated areas in the action alternatives.

Effects Common to All Action Alternatives

The general effects to fuels and potential fire behavior that are common to all of the action alternatives are discussed in this section by general treatment method, vegetation type and silvicultural prescription. Silvicultural prescriptions are located in Appendix A.

There will be differences in effects on fuels and potential fire behavior from the use of different treatment methods. In summary,

- Prescribed burning primarily reduces surface fuels, but can also reduce ladder fuels and canopy fuels as well. This usually results in decreased surface fire intensity and rate of spread in the future and may also result in lower potential for crown fire and spotting.
- Mechanical treatments such as thinning and harvest tend to reduce canopy fuels, or the fuels in the crowns of trees, by thinning trees and increasing the spacing between trees, but they tend to increase surface fuels by adding branchwood and unmerchantable material to the forest floor (Vaillant et al. 2009). This could result in increased surface intensity but lower potential for crowning and spotting.
- Mechanical treatments such as mastication and piling tend to re-size or rearrange fuels. Fuel that is piled and subsequently burned is removed. Mastication tends to reduce torching and crown fire potential by rearranging and re-sizing brush and young trees into compact surface fuel. Piling and burning reduces surface fire intensity and rate of spread.
- When prescribed burning treatments are used after, and in conjunction with, mechanical treatments, the result can be a reduction in canopy, ladder, and surface fuels. Mechanical treatments that are followed up with prescribed fire generally have the most potential to reduce future flame length, rate of spread, torching, crowning, and spotting.
- Note that in treatments where trees are removed, more sunlight and wind can reach surface fuels which tends to increase drying and therefore fire behavior.

Prescribed Burns

Prescribed burning includes both broadcast burning and pile burning. Broadcast burning is the controlled use of fire to burn across a designated area bounded by fireline or other barriers to fire such as roads or rocky areas. Pile burning is localized burning of stacks of fuels which are often the products of mechanical or hand treatments. Smaller piles scattered throughout a treatment unit would tend to be between 100 and 400 feet^2 and 6 to 10 feet high and larger piles created at landings will tend to have a footprint of 400-900 feet^2 and a height of 10-20 feet.

Prescribed burning treatments to enhance aspen regeneration would promote areas where wildfires would burn slowly with low intensity or extinguish.

Mechanical Treatment

Harvest activities could remove approximately 32 tons/acre of dead standing trees which would no longer contribute to the surface fuel loading over time in treatment units (La Garita EA). This reduction in down woody fuels would lead to lower surface fire characteristics such as rate of spread and flame length and potential fire effects in the longer term, until these effects would become counteracted by new vegetation growth.

Residual fuels, or those fuels created by the activities associated with treatment, vary depending on the type of treatment. In spruce areas treated with silvicultural procedures, surface fuel loading and characteristics would depend on whether whole-tree yarding or conventional logging practices were used. Whole-tree yarding is more likely to be used for this project, but it is possible some conventional logging will occur also. Whole-tree yarding is generally accomplished by use of a feller buncher or yarder. The material is then moved via the skid trail to the landing as a ‘whole tree’ and delimbed. During tree felling by chainsaw, limbs and tops would be cut where the tree falls and remain in the stand. The only portion of the tree that would be skidded to the landing would be the merchantable bole. Silvicultural treatments where only the bole is removed would leave almost all the branch wood on the site, which may be piled into smaller piles (100-400 ft^2) across the site or left in place according to silvicultural prescriptions.

In surveys done in beetle-killed Engelmann spruce at the end of a 10-year outbreak on the White River National Forest in 1951, some of which was salvaged, most plots had about 50 tons/acre of fuels, and some plots had loadings as high as 95. Collins et al. (2012) found that salvage logged areas had 3 times higher surface fine (smaller diameter) fuel loadings as untreated areas, though decomposition could negate such effects within approximately two decades. Peterson et al. (2014) found that salvage logging initially increased small and medium surface fuels to a small extent, but decreased large-diameter fuels in the longer term.

Treatments alter surface fire behavior in stands relative to untreated stands. Fire modeling completed for this analysis is indicated in 4, and indicates variation in expected flame length and rate of spread for surface fire.

Post-treatment fuels, whether piled or left in place, may be changed through mastication, chipping, or prescribed fire. Mastication and chipping cut up large fuels into smaller chunks or chips which can range in size. Chipping carries the connotation of even smaller resultant fuel particles. Post-treatment fuels could also be removed through pile-burning or broadcast burning. According to the GMUG Forest Plan Standard and Guidelines, fuels would be treated in management areas 1A, 1B and 1D so that flame heights in a potential fire would be lower than 4 feet. Several years after treatment, herbaceous plants, grasses and shrubs may grow in the treated areas.

Treatments in the Wildland Urban Interface

Recovery, resiliency and hazard tree removal treatments in the WUI will have differing effects for wildland fire management based upon the distance from infrastructure.

The roads, cleared landings and areas where trees are removed may slow fire behavior, could aid mobility of ground-based fire suppression forces, and could serve as anchor points until new tree or brush growth was significant. Hazard tree removal would provide pockets and roads where snag densities are lower, which would reduce snag hazard and could serve as areas on the landscape where fires could be managed.

Multiple locations on the landscape are needed to effectively manage fire because quite frequently, fires may not be stopped with the first attempt fire suppression resources make. Often fires either burn through firelines before they are completed, or embers fly past the fireline and ignite more spot fires across the line than can be contained. It is helpful to also have defensible space in addition to: one or more cleared roads, firelines, or natural fire breaks on the landscape. This contingency of also having defensible space adjacent to structures allows fire suppression resources to either remain in place and defend structures, or reenter soon after the fire front passage if all other firelines are compromised. Additionally, structures with defensible space can have a higher chance of surviving a fire with no suppression resources defending them. Additionally, in order to manage wildfires for resource benefit, multiple control options on the landscape are necessary to allow fires to burn, yet provide reasonable protection to communities and structures.

Design Features

Objectives of fuels-related design feature are:

- Use current science and silvicultural, fuels and fire management practices to achieve an optimum balance between positive and negative effects of slash treatment on soils, hydrology, wildlife and potential fire risk.
- Reduce negative impacts of slash piles (pile burns).

Table 41. Design Features Specific to Fuels Impacts. Excerpt from Appendix B, Design Features.

Design Feature	Trigger for Use	Description	Effect
SP-1	Treatment unit is <100 acres; AND aspen regeneration is the main treatment objective; AND not near infrastructure OR in management areas 1A, 1B or 1D.	Retain slash on the ground	Deter elk browse of aspen seedlings.
SP-2	All mechanical treatments.	A minimum and maximum fuel loading will be specified. Generate associated Brush and Disposal (BD) plan.	Reduces fuels near infrastructure and leaves material onsite for seedling establishment, wildlife benefit and soils health.
SP-3	Treatments in Management Areas 1A, 1B and 1D, (developed recreations sites, ski areas, utility corridors)	Remove residual fuels such that they produce less than four foot flame lengths under 90% of burn conditions.	Avoids increased fuel loading in proximity to high-use areas and infrastructure.
SP-4	All pile burning.	Pile size should be limited as follows: Piles at landings, where soils are impacted by previous yarding and loading, can be up to 20-30' in diameter, or 400-900 square feet. Piles in interior areas of treatment units, where soils are less disturbed, should be limited to 10-20' in diameter (100-400 square feet). Note that too many small piles (<10' diameter) results in inefficiency in burning them. Attempt to keep total area covered by piles/acre under ~5% (<2,500 square feet/acre covered by piles). If piles are created by a bulldozer, use a brush rake to avoid collecting soil and duff in the burn pile. Where landing piles are burned the previously impacted soils should be rehabilitated by scarification following burning. When possible do not place green material exceeding 8" in burn piles.	Minimizes soil impacts from pile burning (sterilization)

Design Feature	Trigger for Use	Description	Effect
		If practicable design projects so activity fuels larger than 8" are removed from the site. Piles should be spaced adequately away from leave trees to reduce damage to trees during burning.	
SP-5	In areas treated for recovery where beetle kill is prominent.	Piles will be burned as soon as burn conditions for pile burning occur (usually first adequate snowfall event). Piles will need to be located in proximity to roads that prescribed burn personnel can reach the site either by motorized vehicle (truck, UTV, ATV, or snowmobile) or by foot without having to hike or ski more than ¼ to ½ mile to reach the piles.	Reduces the likelihood of piles to serve as brood material for beetles.
SP-6	All mechanical treatments.	Reduce activity-generated fuels in compliance with the treatment Brush and Disposal (BD) plan. Fuels, silviculture and timber resources management personnel would develop prescriptions considering economical harvest methods, activity fuels and residual site conditions.	Avoids increased fuel loading.

Each of the design features are incorporated into the effects analysis common to all action alternatives.

Single-story Spruce – Recovery

In single-story spruce, the direct effects of recovery (salvage) treatments on fuels could be lower or higher surface fuels immediately after treatment depending on the silvicultural method used and the prescription for treatment of residual fuels. Whole-tree yarding is the most likely silvicultural method that will be used. Surface fuels could be slightly higher after whole-tree harvesting in recovery than resiliency treatments because some of the branches on the bottoms of tree bundles break off because trees are dead and brittle. Conventional logging would leave additional surface fuels, unless silvicultural prescriptions and/or design features require treatment of residual fuels. Near infrastructure, residual fuels would be pile-burned based on design criteria to negate any change in surface fuel loadings. Broadcast burning of recovery treatment units would result in lower surface fuels loadings. In treated single-story spruce stands, few to no trees would remain after salvage treatment, and so there would be fewer fuels after harvest, few ember sources in the treated area for the near term, and lower fuels additions over the long term relative to untreated dead stands. Most canopy fuels would be removed; such canopy discontinuity can interrupt crown fire on the landscape-scale.

Reductions in larger fuels in treated areas would reduce the residence time of a potential wildfire, lowering fire effects to plants and soil. Although soils would experience high fire severity under burn piles, these effects would be localized and lessened by the design features associated with pile burn rehabilitation.

Multi-story Spruce – Recovery

Effects of recovery treatments on fire and fuels in multi-story spruce would mirror those effects in single-story recovery treatments, however, these stands typically contain more advanced regeneration. Because all silvicultural prescriptions in SBEADMR minimize or avoid impacts to advanced regeneration, treatments in these stands would leave more fuels in the form of patches of young canopy fuels. These could carry fire and loft embers. Additionally, due to the desire to maintain advanced regeneration on site, broadcast burning would be less likely, resulting in some areas with increased surface fuels. This would lead to slightly higher potential surface fire rates of spread, flame lengths and spotting potential than in single-story spruce stands treated for recovery.

Reductions in larger fuels in treated areas would reduce the residence time of a potential wildfire, lowering fire effects to plants and soil. Although soils would experience high fire severity under burn piles, these effects would be localized and lessened by the design features associated with pile burn rehabilitation.

Aspen without SAD or <50% SAD

In aspen stands without SAD or with <50% SAD, pre-treatment stand conditions may generally have the lowest surface fuels and canopy fuels of all the aspen vegetation categories in this report. Treatments would consist of either coppice cutting with or without pile/broadcast burning to reduce residual slash or broadcast burning.

If residual slash were pile or broadcast burned, surface fuels, and the concomitant increase in potential surface fire intensity, would be avoided.

In areas where broadcast burning is used without tree harvest, surface fuels would initially be decreased, and so would the potential surface fire behavior characteristics. Many or all overstory aspen would be killed, and over time surface fuels could increase as these trees fall. This treatment should trigger aspen to resprout vigorously, yielding a layer of live tree sprouts in which fire potential would be very low. Future wildfires which burn into the stand would tend to slow down or go out. In and near the WUI, such treatments would allow firefighters to access and remain in areas to protect communities and infrastructure. Outside the WUI, these treated areas could serve as anchor points in the event of managing or suppressing a wildfire.

Aspen with >50% SAD

In aspen stands with > 50% SAD, research has indicated that treatments may not be effective at inducing sprouting, so prescriptions would be developed on a site-by-site basis. For instance, in WUI, marginal aspen treatments may be implemented in an effort to maintain a slower burning fuel and avoid establishment of other vegetation types which would burn more intensely.

Aspen Overstory and Spruce-fir Understory

In stands with aspen overstory and spruce-fir understory, pre-treatment conditions would likely have higher ladder fuels than pure aspen stands due to the more flammable understory of young spruce-fir. Similar to the other aspen types, treatment prescriptions would include broadcast burning and coppice cutting with or without pile or broadcast burning to reduce residual slash, however, because fire is difficult to control in this vegetation type due to the spruce, broadcast burning would only be used on a case-by-case basis. The effects of treatments in this aspen vegetation type would be similar to those of aspen stands without SAD or with <50% SAD; in addition, by inducing aspen regeneration and removing the spruce understory, the potential surface fire intensity and potential crown fire would be much lower than pre-treatment conditions.

Mixed Conifer with Aspen

In mixed conifer with aspen stands, initial fuel conditions would have the highest potential fire intensities of all the aspen types due to surface, ladder and canopy fuels associated with the conifer component. Treatment prescriptions in this vegetation type would include removal of spruce and prescribed burning. The effects of spruce removal could be an increase or decrease in surface fuels depending on whether whole-tree or conventional logging were used and the associated fuel treatment. Much of the flammable canopy fuels would be removed, leading to much lower crown fire potential. Prescribed fire would reduce surface fuels and could kill aspen and trigger resprouting. Over time, the dead aspen would fall, increasing surface fuels. This treatment should trigger aspen to resprout, yielding a layer of live tree sprouts in which fire potential would be very low. If enough of the mixed conifer component were removed through treatment, future wildfires which burn into the stand would tend to slow down or go out.

Alternative 2 (Proposed Action) – Direct and Indirect Effects

The direct effects of Alternative 2 on fuels, fire behavior and the ability of wildland firefighters to manage fires would not be limited to the WUI as in Alternative 3.

In addition to the effects common to all action alternatives, the direct effects of Alternative 2 on fire and fuels include effects from spruce resiliency treatments, noted below.

Resiliency Treatments in Single-Story Spruce

The pre-treatment conditions in single-storied spruce stands where resiliency treatment will be applied will likely tend to have slightly lower surface fuels than recovery treatment areas because these will be stands of live trees, which are not shedding needles at the rate of dead trees. In single-story spruce, the direct effects of resiliency (ITS and group selection) treatments on fuels would also depend on the silivcultural and fuels prescriptions, however, broadcast burning is these treatments is less likely due to the value of residual trees in the surrounding areas. In resiliency treatments, where live trees are being harvested, fewer branches would break during harvest compared to salvage, meaning slightly lower surface fuels. In single-story spruce treated with resiliency, few trees would remain in the patch cuts, meaning very few to no ladder and canopy fuels would remain. Resiliency treatments in spruce which reduce most canopy fuels may have the effect of interrupting crown fire on the landscape scale.

Reductions in larger fuels in treated areas would reduce the residence time of a potential wildfire, lowering fire effects to plants and soil. Although soils would experience high fire severity under burn piles, these effects would be localized and lessened by the design features associated with pile burn rehabilitation.

Resiliency Treatments in Multi-Story Spruce

Effects of resiliency treatments on fire and fuels in multi-story spruce would mirror those effects in single-story resiliency treatments, however, these stands typically contain more advanced regeneration. Because all silvicultural prescriptions in SBEADMR minimize or avoid impacts to advanced regeneration, treatments in these stands would leave more fuels in the form of patches of young canopy fuels which could carry fire and loft embers. Additionally, due to the value of residual trees surrounding the areas from which trees were removed, broadcast burning is less likely, leading to higher surface fuels than in the single-story stands treated for resiliency. This would lead to slightly higher potential surface fire rates of spread, flame lengths and spotting potential occurring than in single-story spruce stands treated for resiliency. The effects of patch cuts acting to interrupt crown fire could be slightly reduced compared to single-story treatments since the young tree component would remain.

Reductions in larger fuels in treated areas would reduce the residence time of a potential wildfire, lowering fire effects to plants and soil. Although soils would experience high fire severity under burn piles, these effects would be localized and lessened by the design features associated with pile burn rehabilitation.

The indirect effects of Alternative 2 on fuels, fire behavior and the ability of wildland firefighters to manage fires would not be limited to the WUI as in Alternative 3.

Alternative 2 (Proposed Action) – Cumulative Effects

In comparison to the No Action Alternative, cumulative effects of Alternative 2, in combination with other ongoing and reasonable foreseeable activities in the project area (see cumulative effects analysis for the No Action), would include more areas of reduced fuels across the landscape, though the scale of such treatments would be small. SBEADMR would treat a maximum of 4% of the GMUG, or approximately 8% of aspen and spruce-fir on the landscape. If the GMUG retained capacity to do maximum SBEADMR treatments and other reasonable foreseeable treatments in a similar timeframe, the percent of the landscape treated may rise to 5%. Given the stand-replacing, climate-driven wildfire behavior in spruce-fir, the cumulative effects on wildfires at the landscape-scale of Alternative 2 would likely continue to be insignificant.

Yet at the site-scale, some reduction of fuels, ember sources and concomitant fire intensity would occur in spruce-fir. Areas with lower surface fuels due to salvage may experience lower percentages of areas with high soil fire severity after wildfires. Having fewer high-severity acres across the landscape would result in fewer acres per watershed with disrupted nutrient cycling or water repellency characteristics. To those with values at risk in the wildland urban interface, and to wildland firefighters tasked with protecting such values at risk, treated fuels and hazard trees at the site-scale would lead to improved safety and efficacy for wildland firefighters, even if the frequency and extent of wildfires at the landscape-scale would be relatively unaffected.

Some invasive species (such as cheat grass) could be proliferated by fire-related disturbances. Conversely, vegetation treatments without the fire vector could result in an increase in invasive species such as cheat grass, which could increase fine fuel loading; however, this is a shade intolerant species which is likely to be out-competed when regeneration of tree species occurs.

Alternative 3 (Public Safety) – Direct and Indirect Effects

In general, the direct effects on fire and fuels of Alternative 3 would be very similar to the Proposed Action because the treatment types and total acres treated in the project lifetime would be the same. The clearest difference between the effects of Alternative 3 and the Proposed Action is that in Alternative 3, all treatments – and therefore, fuels reduction – would be spatially limited to the WUI and near infrastructure, concentrating the direct effects into a smaller area.

In this alternative, there would be no treatments outside of the WUI and hazard tree removal areas, and fire managers would not have a reduction in snags or any areas of lowered fuels or anchor points outside of such areas.

Effects particular to various treatments are discussed in the Effects Common to all Action Alternatives section.

There is a higher likelihood that fewer burn acres in Alternative 3 will be accomplished than in the Proposed Action. In Alternative 3, the treatments will be limited to the 1-mile buffer around communities and developed parcels (WUI) and to hazard tree removal outside the WUI. Any broadcast burning, therefore, would only occur in the WUI. There are several factors that make broadcast burning in the WUI more challenging, including more values at risk, increased public interest, smoke management concerns, increased burn preparation, tighter burn prescriptions, and larger, more expensive burn organizations. .

As a result, fewer acres across the GMUG would receive aspen regeneration treatments, reducing impacts of such treatments relative to the other action alternatives.

In general, the indirect effects of Alternative 3 on fire and fuels would be similar to the Proposed Action because the treatment types and total acres treated in the project lifetime would be the same. However, in comparison to the Proposed Action, the spatial distribution of treatments would be more limited, which would lead to fewer benefits related to firefighting and reducing the spread of wildfires across the wider landscape.

Wildland fires burning near and through the WUI would burn through a higher density of treatments where fuels have been reduced, which could have the effect of better interruption of crown fire runs in these areas. Additionally, a higher density of cleared landings and a higher reduction of removed hazard trees in the WUI could aid fire suppression forces more in the area in which their actions are most important, near infrastructure and homes. Pile burns would be used more often due to all treatments being in greater proximity to infrastructure.

As noted above, there is a higher likelihood that fewer burn acres in Alternative 3 would be accomplished than in the Proposed Action. With fewer aspen regeneration treatments, indirect effects include higher potential surface fire behavior for several years following treatment and continued succession of such stands to brush and/or conifer species.

Alternative 3 (Public Safety) – Cumulative Effects

In general, the cumulative effects of Alternative 3 would be very similar to the Proposed Action because the treatment types and total acres treated in the project lifetime would be the same. However, the cumulative effects would be more concentrated in the WUI and roadsides.

Alternative 4 (Spruce Salvage) – Direct and Indirect Effects

In Alternative 4, more standing dead trees would be removed because no spruce resiliency treatments would be implemented. None of the single- or multi-story spruce resiliency effects described in the Proposed Action would occur. If all commercial treatments were to take place in spruce rather than aspen (if no aspen market were to develop), then all 60,000 acres of commercial treatment would be salvage of beetle-affected spruce in Alternative 4. The effects of

spruce treatments on fuels would be the same as those discussed under the single- and multi-story spruce recovery sections of the 'Effects Common to all Action Alternatives,' however, would occur across more dead and dying acres relative to the other Alternatives, due to the lack of resiliency treaments in spruce-fir. This means the direct effects of Alternative 4 include fewer ember sources from dead and dying trees after treatment. However, because all spruce treatments would involve harvest of dead trees, surface fuels could be elevated due to more branch breakage during harvest.

Direct effects of aspen treatment would remain the same as in the Proposed Action.

Focusing all efforts in spruce on the removal of beetle-infected trees would result a greater reduction of crown fire behavior and ember lofting than in the other two alternatives, and possibly slightly lower crown fire potential across the landscape.

Aspen treatments and effects would remain the same as the Proposed Action.

Alternative 4 (Spruce Salvage) – Cumulative Effects

In general, the cumulative effects of Alternative 3 would be very similar to the Proposed Action because the treatment types and total acres treated in the project lifetime would be the same.

Biological Environment

Compliance with Regulatory Direction

Forest Service Policy and Direction:

Forest Service Manual 2670: Directs Forest Service to manage habitat for existing native and desired nonnative plants, fish and wildlife species, as well as threatened and endangered species, and to develop and implement management practices to ensure that species do not become threatened or endangered because of Forest Service Actions."

Forest Service Manual Rocky Mountain Region (Region 2) 2670.32: "Integrate available scientific information, including Regional species evaluations, species and ecosystem assessments, and conservation strategies, into Forest Service planning and implementation…"; The Manual also includes direction on conducting inventories and monitoring sensitive species, and managing for sensitive species in groups and habitat complexes when feasible.

There is no language in the current Land and Resource Management Plan, nor Standards and Guides that pertain to Threatened, Endangered or Forest Service Sensitive Plants.

Botany

Analysis Methodology

The following analysis is based upon professional knowledge, the best available science, and existing population information. Due to the size of the project analysis (opportunity) area, and the adaptive implementation approach to choose precise treatment locations within the opportunity areas, the "worst case scenario" will be presented within the range of potential outcomes. Effects are analyzed for known populations and for potential habitats which will be discussed in the context of occupied habitats, (though this can conflate the number of potential populations). As the main difference between the alternatives is the spatial area that they could occur in, and there has not been ground reconnaissance conducted to determine whether or not sensitive species are present, or even if suitable habitat may be present, a comparison of opportunity areas will be a proxy for magnitude of impacts. The adaptive implementation approach will be followed which will ensure completion of required surveys and design of treatments and associated activities to avoid or minimize effects to TEPS plants.

Assumptions Made

The following assumptions relate to the alternatives considered in this document and their effects on sensitive plant species:

- Design features to avoid or minimize direct and indirect impacts will be implemented as needed on all projects.
- The action alternatives have areas common to all; where these alternatives overlap, the impacts and effects to sensitive plant populations will be identical.
- Fens, meadows, and riparian areas will not have pile burning, heavy machinery, vehicle traffic, or timber harvest occurring in them.
- It is assumed that the types of impacts that have the potential to affect sensitive species are the same for all action alternatives. The effects will be dependent on the location where the treatments occur and whether there are sensitive species present or potentially could occur.

Criteria Used to Determine Impacts

The following criteria were used to determine whether sensitive plant species would be affected by project implementation:

- Whether the species occurs or has the potential to occur within the treatment area;
- The likelihood of impacts to suitable habitat;
- The nature and extent of impacts anticipated as a result of each alternative;

- The life cycle of the species present or potentially present, and the resulting anticipated response to disturbance;
- The existence of or potential for other impacts to sensitive plant species within the cumulative effects analysis area.

For the purpose of this analysis, cumulative effects are bound in space by the Forest Boundary. Cumulative effects will be bound by ten to twelve years into the future because this encompasses the life of the project. Past effects will be considered a part of the baseline conditions as presented in affected environment. The cumulative effects framework used for this project is not being applied to botany because cumulative effects in this specialty are not affected by/driven by the placement of treatment acreages and their effect on lynx habitat as much as design criteria.

Affected Environment

Species Considered for Analysis

Of the two federally threatened and twenty-four sensitive plant species with the potential to occur on the GMUG, twelve sensitive species were determined to fall within the elevation and distributional ranges of the project alternatives, and to have suitable habitat that could be impacted by any of the alternatives. Neither of the threatened species will be affected by any of the alternatives. Species that will be considered in effects analysis include:

Lesser panicled sedge (*Carex diandra),* round leaf sundew *(Drosera rotundifolia),* Altai cottongrass (*Eriophorum altaicum var. neogaeum),* Chammiso's cottongrass (*Eriophorum chamissonis),* slender cottongrass (*Eriophorum gracile),* sageleaf willow (*Salix candida),* sphagnum moss (*Sphagnum angustifolium),* lesser bladderwort (*Utricularia minor),* park milkvetch (*Astragalus leptaleus),* Colorado tansy aster *(Machaeranthera coloradensis),* narrowleaf grapfern (*Botrychium lineare)* and peculiar moonwort (*Botrychium paradoxum).*

Features considered for eliminating a species from consideration from further analysis include:

1. Species is outside of the known distributional and elevation range of the areas potentially affected by alternatives (e. g., alpine species, low elevation species)
2. Species is not known to occur near roads used for project activities
3. Species is known from specific edaphic types that are not included in any of the SBEADMR alternatives.

The primary target habitat for the SBEADMR project is Engelmann spruce-subalpine fir (*Picea engelmannii-Abies bifolia*) and aspen (*Populus tremuloides*) vegetation types. Both spruce-fir and aspen occur as or within a matrix of other vegetation types. Spruce-fir forms the primary matrix systems of the subalpine zone in the Southern Rocky Mountains (Gregg 1963, Colorado Natural Heritage Program 2005, Johnston and others 2001). Aspen is a common constituent in

this vegetation type, but also can form homogeneous stands; aspen can also occur in the lower-elevation montane zone (Johnston and others 2001). The species considered in this document generally occur in rare or unusual habitats within the montane and subalpine zones.

For purposes of analysis and description the species considered in effects analysis will be grouped for discussion. This approach is useful in this effects analysis as the sensitive species are in varying degrees dependent on some threshold of habitat integrity, or some habitat constituent. This dependence is generally based on some sort of ecosystem process (e.g., disturbance) or physiological preference/adaptation (e.g., high hydrologic needs). When approached from this angle, impacts to the integrity of the habitat can be inferred to be associated with the suitability and sustainability of the habitat for individual populations.

Table 42. Sensitive Plant Species on the GMUG, by Habitat

Habitat	Sensitive Plants
Montane parks and alpine	Colorado tansy aster
Moist swales and riparian meadows	park milkvetch
Fens and other wetlands	lesser panicled sedge round leaf sundew Altai cottongrass Chammiso's cottongrass slender cottongrass sageleaf willow sphagnum moss lesser bladderwort
Lightly-disturbed microsites (old roads and road cuts) within mesic coniferous stands	narrowleaf grapefern peculiar moonwort

Past and current activities have altered sensitive plant populations and their habitats. These activities have the potential to cumulatively affect sensitive species. These current and past activities include: grazing, timber harvest and thinning, fire suppression, prescribed fire, mining, motorized and non-motorized recreational use, road construction and maintenance and urban development. Some of the effects of these activities that have and continue to affect sensitive plants could be reduced vigor or population viability due to trampling by grazers or browsers, changed environmental conditions due to timber harvest, decreased resource availability due to competition with invasive plants, or direct mortality.

Mesic Conifer Forests

Narrowleaf grapefern and peculiar moonwort are found in habitats with some overhead canopy, often where past disturbance has occurred historically, such as closed roads or regenerating roadside pullouts. Overhead canopy can be provided by young trees or medium-height to small

forbs. Potential habitat could be found within the aspen, spruce-fir, lodgepole, and cool-moist mixed conifer cover types in alpine and subalpine zones. Mycorrhizal relationships are very important, for all *Botrychium* species have a mycorrhizal relationship with soil fungi (Beatty and others 2003). This would be the habitat constituent that is the most critical for maintaining suitable habitat for *Botrychium.* This habitat is present throughout the forest, and is difficult or quantify as far as baseline conditions.

On the GMUG, narrowleaf grapefern grows in the upper subalpine zone, in historically disturbed areas (often very near roadsides and a few sites on old earthen dams), usually in rocky or coarse textured soils. Narrowleaf grapefern was recently discovered on and adjacent to the GMUG at seven locations. In Colorado it is known from elevations ranging from 7,900 to 9,500 feet. While it is widely distributed, especially throughout the mountains of Western North America, populations are very sporadic. Most populations are tiny, amounting to a few hundred total individuals worldwide.

Peculiar moonwort is a plant of mesic subalpine mountain meadows dominated by grasses, sedges and in some cases, dense herbaceous and shrubby cover (Farrar 2011). In Colorado, suitable habitat has not been clearly determined, but peculiar moonwort has been found in open rocky alpine or subalpine areas at elevations above approximately 10,500 feet. Peculiar moonwort occurs from south central Utah and Colorado northward to Montana and Washington and into southern British Columbia, Alberta and Saskatchewan, and is disjunct in the Sierra Mountains of east-central California. The Colorado distribution is limited to one location on the Grand Mesa, Uncompahgre and Gunnison National Forest in Crested Butte.

Narrowleaf grapefern is considered among the rarest vascular plants in Colorado. Disturbances and land management activities may create and maintain suitable habitat but also may negatively impact existing populations depending on the disturbance intensity and frequency. There is little information about impacts to peculiar moonwort in Colorado, but as it is known from a single population at this time, it is sensitive to extirpation through this part of its range.

There is the potential for narrowleaf grapefern and peculiar moonwort to occur throughout the SBEADMR treatment opportunity area where suitable habitat exists, primarily in old roadbeds throughout the spruce-fir and other mesic conifer types.

Montane Parks

Colorado tansy aster is found in areas with open exposure and soils in montane parks, and usually occurs on certain geological formations, tuffs with some tendency toward higher pH, limy in character (Beatty and others 2004). On Colorado tansy aster sites, species cover varies widely, from nearly barren slopes, to Idahoe fescue (*Festuca arizonica)* grasslands, to low

sagebrush or rabbitbrush shrublands; but the Colorado tansy aster plants always occur in open microsites within those communities.

Colorado tansy aster also occurs on alpine slopes, again in open microsites and associated with limy geologic substrates (Beatty and others 2004). Colorado tansy aster is endemic to Wyoming and Colorado, ranging from southern Colorado to the Medicine Bow National Forest in southeastern Wyoming. In Colorado known populations exist in Chaffee, Gunnison, Hinsdale, La Plata, Lake, Mineral, Park, Pitkin, Saguache, and San Juan Counties. Colorado tansy aster is known from at least 36 populations in Colorado, with approximately half of these on the GMUG.

Colorado tansy aster is vulnerable to threats because of the restricted geographic range. The populations at greatest risk are those lower elevation populations adjacent to, or in roads. Other potential threats include motorized and non-motorized recreation, trail and/or road construction and maintenance, reservoir expansion, housing development, changes to natural disturbance regimes, livestock, and invasive species.

Colorado tansy aster is known to occur in SBEADMR treatment opportunity areas, and has the potential for additional populations where suitable habitat exists. This species appears to be somewhat resistant to trampling, since it has been observed in beds of seldom-used roads, and seems to do well in areas frequented by cattle or deer.

Wetlands

Wetlands, including fens, are estimated to occupy about 0.4% of the GMUG (Johnston and others 2012), that is, about one in every 223 acres. Few of these wetlands occur associated with a stream, but most are round or oval. In the subalpine and montane zones, wetlands are dominated by obligate wetland plants (Lichvar 2012), which on the GMUG include species such as beaked sedge (*Carex utriculata*), water sedge (*C. aquatilis*), and sometimes one or more willow species.

Use of wetlands on the National Forests, and access to them, is managed by the Forest Service under the Clean Water Act[7] and its implementing regulations, especially the wetland mitigation regulations.[8] In the Forest Service, wetlands are surrounded by a buffer called the *water influence zone* (USDA Forest Service 2006b). Since laws, regulations and Forest Service policies and best management practices (USDA Forest Service 2012c) severely restrict any activities in wetlands and limit activities in the water influence zone around them, activities implementing

[7] 33 U. S. Code § 1251 and following.

[8] 33 Code of Federal Regulations 325-332 and 40 CFR 230; see Federal Register 73(70):19594-19705 of April 10, 2008.

this project will usually avoid wetlands. The following are discussions on the specific types of wetlands that sensitive plants are known to occur in.

Moist Swales and Riparian Meadows

Park milkvetch grows in lower elevation riparian areas and subriparian swales, typically sedge-grass dominated meadows, swales and hummocks, and streamsides; its population and distribution is not well known, however. Park milkvetch is considered a regional endemic that is known from Colorado, Idaho, Montana and Wyoming. In Colorado it is known from Jackson, Larimer, Summit, Park and Gunnison Counties. On the GMUG, park milkvetch is known to occur in the Gunnison Basin, and has the potential to occur in FS lands on the Gunnison District[9].

Riparian and sub-riparian grass-sedge swales occur near streams or stream courses; most of these areas would be included within riparian areas according to the definition in the current Forest Plan (USDA Forest Service 1991c), and so would fall under the direction for Management Area 9A in that plan. Park milkvetch is thought to be vulnerable primarily due to loss, degradation and/or fragmentation of habitat. As park milkvetch is known from lower elevation riparian areas and hay meadows, it is thought to have vulnerability to invasive species, activities that dry habitat out like hay farming, and livestock grazing. Other potential threats include off-road vehicles, camping, road development, drought, and potentially closing of the forest canopy due to fire suppression.

There is the potential for park milkvetch to occur in the SBEADMR treatment opportunity area, especially on the Gunnison District in areas where suitable habitat exists.

National and regional best management practices include buffers around streams, called water influence zones (USDA Forest Service 2006-2012). The water influence zone is a minimum of 100 feet on either side of the stream, usually expanded to include the distinctive riparian vegetation and often the floodplain as well. It is likely that populations of park milkvetch would occur within the water influence zone.

There are special restrictions on use of water influence zones, especially with road construction and other activities involving heavy equipment. It is not known how large the populations of park milkvetch are, but seems likely they are fairly small in extent, and so would be relatively easy to avoid by activities planned in this project.

Fens

Fens are "wetlands with waterlogged substrates and approximately 30 cm or more of peat accumulation" (Chadde and others 1998, also see Johnston and others 2012), characterized as having water tables near the soil surface. Fens are types of peatland that have been characterized for the GMUG as having 30 cm of peat in the top 80 cm, and anaerobic conditions where peat is accumulating (Johnston and others 2012). Fens are hydrologically dependent on groundwater discharge, and generally experience saturation to soil surface (Bedford and Godwin 2003). Acidic fens (also referred to as "poor fens") are generally dominated by bryophytes with scattered vascular plants.

Nine of the sensitive species considered in this EIS are known to occur in fens (lesser panicled sedge, round leaf sundew, Altai cottongrass, Chammiso's cottongrass, slender cottongrass, sageleaf willow, sphagnum moss, and lesser bladderwort). Round leaf sundew and sphagnum moss are known to prefer acidic fens. Neutral to alkaline fens (also known as "rich fens") and generally dominated by vascular plants, primarily sedge species (Chadde and others 1998). Lesser panicled sedge and sageleaf willow are known to occur in primarily in rich fens.

A fen inventory conducted on the GMUG in 2009-2010 estimates that there are approximately 1,738 fens covering 11,034 acres, with half of them being less than four acres in size. Fens on the GMUG are concentrated in the Grand Mesa, Sawatch Mountains and San Juans, and most are known to occur between the elevations of 9,000 to 11,900 feet. This inventory also rated fen condition, finding 81% of the fens in "high" condition, 18% in moderate condition, and 1% in low condition. Fen communities are very sensitive to hydrologic alterations, and once function has been impaired, restoration may be possible but is a lengthy and expensive process. The primary factors on the GMUG that are known to be causal agents of degradation or disturbance in and adjacent to fens are browsing and grazing; historic mining activities; construction, use and maintenance of roads and trails; and flooding, and beaver activity. The lowest-scored condition class fens were highly altered by flooding from adjacent reservoirs, historic mining and grazing activities (causing channelization and hence dewatering), all of which are activities that alter the hydrologic functioning.

The ideal buffer around fens is 100 meters (328 feet) from the outer edge of the wetland complex (Castelle 1992, Rocchio 2006), which defines the ideal water influence zone for fens. Fens are usually considered irreplaceable because the peat in fens accumulates at such a slow rate (U. S. Fish and Wildlife Service 1999, USDA Forest Service 2011d). For these reasons, Forest Service policy is to conserve or restore fens (USDA Forest Service 2011d).

On the GMUG, fens occupy about 0.14% of the landscape, that is, about one acre in every 715. Fens are small to very small features. Forest Service policies and best management practices nationally (USDA Forest Service 2012c) and regionally (USDA Forest Service 2006b) severely

restrict any activities in wetlands (including fens) and limit activities in the water influence zone around them; as a result, activities implementing this project will avoid fens.

Alternative 1 (No Action) - Direct and Indirect Effects

This alternative is used as a basis for comparing the effects of the Proposed Action and other alternatives. It assumes no implementation of any elements of the proposed action or the action alternatives. Under the no action alternative, spruce-fir mortality and aspen decline are anticipated to continue unmitigated. The actual trajectory of mortality is not predictable, but it is assumed that in the spruce-fir, unless some carrying capacity for the beetles is reached, they will continue to move into uninfested areas and kill large diameter trees first, then move to the smaller diameter trees. It is also assumed that aspen will continue to decline, and may experience sudden periodic decreases as were seen with the recent sudden aspen decline epidemic. These events will result in overstory mortality in both spruce and aspen stands. In spruce stands, dead trees will mostly remain standing for several decades[10], but in dead aspen stands, there will be high levels of down trees in the forest.

Scientists are divided on whether a large-scale spruce beetle epidemic (such as we are experiencing) increases fire behavior, effects and fire risk. The actual risk of fire is at this time unknown. However, fires in beetle-killed spruce will be larger and may burn with more surface fire intensity. High-severity wildfire could result in passive indirect effects to sensitive plant species including changes to microhabitat making it less or more suitable. Because one goal of the action alternatives is to reduce the likelihood of high severity wildfire, it is assumed that without the proposed actions, there would be an increased risk of high severity wildfire.

Recent large wildfires in southwestern Colorado have coincided with periods of drought, which will be more unpredictable and more severe as the climate changes (White and others 2013, Williams and others 2012). More severe drought periods will increase the likelihood of severe fires in the spruce-fir zone (Allen and others 2010), and greater likelihood of episodes of sudden aspen decline (Carnicera and others 2011, Worrall and others 2013).This situation could passively adversely affect all sensitive species by increasing interspecific competition, habitat loss, and indirect habitat loss due to increases in invasive plants. With abundant biomass, both standing and on the ground, resulting severe wildfires could result in areas with lethal soil heating which would adversely impact any sensitive species that was present, but also could impact vigor of populations by impacting mycorrhizal relationships (especially with *Botrychium* species).

[10] Roy Mask, pers. comm.

Intense ground heating from severe wildfires usually results in conditions causing major erosion events (Robichaud and others 2000, Peppin and others 2010, Johnston 2012), potentially causing sedimentation events in fens. Sedimentation in fens retards (or even stops) the peat formation process (D. Weixelman, pers. comm. 2014), changes community structure and could cover, or bury sensitive plants. Lethal soil heating could also result in the direct mortality of individuals, or populations, or seed or spore banks.

Any beneficial passive impacts that wildfire might have on disturbance niche species such as Colorado tansy aster, narrowleaf grapefern, and peculiar moonwort, would be overcome by the soil and habitat loss following sever wildfires. These species appear to be stimulated by varying degrees of disturbance and reduced overstory cover. The relationship between specific coverage and optimal vigor is not known for these species, but given their known habitat, high severity fire would likely result in extensive soil and ground cover loss and removal of too much of the overstory, resulting in adverse impacts.

The primary difference with wildfire in spruce beetle-killed stands that would affect sensitive species is the increased intensity and residence time of fire on the soil (Robichaud and others 2000-2006). Analysis of the potential passive indirect effects of high severity wildfire is thus assessed in the analysis of the No Action Alternative, but while these effects are assumed to be more likely with No Action, no alternative eliminates this risk. There is a small risk to these passive effects.

Direct and Indirect Effects Common to All Action Alternatives

Activities were identified from the action alternatives that have the potential to create environmental effects that may impact sensitive species or their habitats. These activities include:

- Increased vehicular traffic and moving of heavy equipment
- Creation and use of staging areas and landings
- Prescribed fire, ground ignition or aerial ignition, including pile burning
- Fireline construction
- Mastication (including chipping)
- Mechanical timber harvest, including site preparation
- Replanting trees and revegetation of new and reconstructed roads
- Road construction, reconstruction, and maintenance
- Road decommissioning
- Treatment of invasives and weeds
- Dust abatement
- Treatments for hazard trees or fuels reduction

Design features as are an integral part of the effects analysis and determination. Design features were developed in response to the foreseeable adverse impacts to sensitive species) as discussed in the effects analysis below. Design feature development and emphasis focused on reducing, if not eliminating, impacts that were likely to lead to losses in viability.

Table 43. Design Features for Sensitive Species for all SBEADMR Project Alternatives.

Sensitive Species of Concern	**Trigger for Use**	**Design Feature**	**Design Criteria Function in reducing effects**
Upland (non-wetland) Sensitive Species	Potential habitat exists in the project area.	FSSP-1A: Sensitive plant populations will be flagged and avoided for all ground disturbing activities with a buffer of 20 – 100 feet (as determined during project analysis).	Prevent take of individuals or populations that would lead to a loss in viability
		FSSP-1B: Disturbances including road construction, reconstruction, landings, skid trails and staging areas in potential habitat for sensitive species will be surveyed by a qualified botanist in the proper season prior to implementation.	
All Sensitive Species	Potential habitat exists in the project are or wetland.	FSSP-2A: During prescribed fire operations (including aerial or ground broadcast burning), ignitions and other fuel treatment activities would be located away from sensitive plant species populations and wetlands.	Prevent toxicity to individuals or populations that would contribute to a loss in viability.
		FSSP-2B: Dust abatement (use of $MgCl_2$ or $CaCl_2$) will avoid sensitive species populations and wetlands by 500 feet.	
		FSSP-2C: Avoid sensitive species populations and wetlands with chemical weed treatments.	
	Allow for adequate planning time to analyze and develop treatment-specific recommendations and appropriate protection measures.	FSSP-2D: Pre-project implementation assessment will be conducted by a qualified botanist. Notification will be given with sufficient time for field surveys during the proper season to be conducted for sensitive plant species expected to occur in the project area or affected by it.	Identification of sensitive plants in the project area to avoid potential impacts all together or selection of appropriate design feature to minimize impacts.

Sensitive Species of Concern	Trigger for Use	Design Feature	Design Criteria Function in reducing effects
		FSSP-2E: Any Region 2 sensitive plant species new to list or located after contract or permit issuance will be appropriately managed by active coordination between permittee, contractor or purchaser, Forest Service line officer, project administrator, and botanist.	During implementation, coordination with botanist will ensure protection of sensitive plants through implementation of design features.
Colorado tansy aster, narrowleaf grapefern, peculiar moonwort	Documented occurrence of the species in the project area.	FSSP-3A: Minimize traffic on roads passing through known sensitive species sites.	Prevent take of individuals or populations that would lead to a loss in viability.
		FSSP-4A: Proposed road construction, reconstruction, landings and staging areas in potential habitat for sensitive species will be designed and marked on the ground only after the areas have been surveyed by a qualified botanist in the proper season.	
		FSSP-4B: If there is tree canopy covering occupied habitat, maintain pre-project tree canopy over habitat.	
Fen sensitive species: lesser panicled sedge, round leaf sundew, Altai cottongrass, Chamisso's cottongrass, slender cottongrass, sageleaf willow, sphagnum moss, lesser bladderwort	Documented occurrence of the species in the project area or a fen.	FSSP-6A: Keep roads and trails out of wetlands and their water influence zones (WIZ).[11]	Reduce potential for recreation-related resource damage to fens.
		FSSP-5A: During treatment, consider signing or close temporary roads if near a wetland.	
	Presence of a fen or riparian area in the project area.	FSSP-6B: Restore existing disturbed areas that are eroding and contributing sediment to the wetland.	Maintain fen hydrologic function by avoiding soil compaction, water diversion, and dewatering which would reduce suitability/sustainability of rare fen habitat.
		FSSP-6C: Delineate Water Influence Zone (WIZ) prior to project implementation according to Regional and National Standards.[12]	
		FSSP-6D: No mechanized equipment operation will occur in the water influence zone (WIZ) of a wetland.	

[11] USDA Forest Service 2006.

[12] USDA Forest Service 2006, 2012.

Sensitive Species of Concern	Trigger for Use	Design Feature	Design Criteria Function in reducing effects
		FSSP-6D: No treatment activities or vehicle use in wetlands or their water influence zones.	
	Presence of a fen or riparian area in the project area.	FSSP-7C:Prevent mineral sediment deposition from occurring in wetlands.[3]	Prevent take of individuals or populations that would lead to a loss in viability.
		FSSP-8A: Develop an erosion and sediment control plan to avoid or minimize downstream impacts using measures appropriate to the site and the proposed activity.[13]	
	When prescribed fire, pile burning or commercial mechanical treatments are proposed.	FSSP-8B: Manage land treatments to limit the sum of severely burned soil and detrimentally compacted, eroded, and displaced soil to no more than 15% of any activity area.	Prevent sedimentation events that would reduce or impair wetland functions. Minimizes adverse impact to soil resources to less than 15% of an activity area. Maintaining healthy soil resource ensures long-term productivity of the site.
		FSSP-8C: Limit roads and other disturbed sites to the minimum feasible number, width, and total length. Minimize sediment discharge into streams, lakes, and wetlands during construction and stabilize and maintain disturbed sites to control erosion.	
		FSSP-8D: Maintain sufficient upslope ground cover to prevent sediment movement downward into wetland.	
		FSSP-8E: Reclaim roads, landings and other disturbed sites when use ends.	Restoration of soil resource and re-establishment of vegetative cover.
		FSSP-9A: Avoid treatment activities and equipment use in wet or moist meadows.	Prevent sedimentation events that would reduce or impair wetland functions.
park milkvetch	Presence of wetlands, streams and moist meadows in the project area.	FSSP-9B: Design stream crossings at armored points, or armor them to prevent loss of functions in wet or moist meadows.	Reduce sedimentation and maintains functional floodplain.
		FSSP-9A: Avoid treatment activities and equipment use in wet or moist meadows.	Prevent sedimentation events that would reduce or impair wetland functions

[13] USDA Forest Service 2012, Austin 2008.

This analysis considers management activities of all action alternatives and associated design features set forth in this EIS. Impacts to plants can be a direct result of the action or may result in a changed environmental condition that alters a biological or physical process that results in an indirect impact to the individual species.

Both direct and indirect impacts can result in adverse or beneficial effects that ultimately affect the overall capacity of the species to persist as an individual plant, as a single population, a group of populations in a local area, or as a biological entity.

Resulting environmental conditions that could lead to impacts (adverse or beneficial) to sensitive plants or their habitats have been identified for the action alternatives based on anticipated project-related activities (Table 44). The activities associated with the action alternatives can result in similar resulting conditions; for example, both hand thinning and mastication would result in somewhat different levels of soil disturbance. The magnitude of the resulting condition and hence the magnitude of anticipated indirect or direct impacts will vary from different methods of treatment and project associated activities.

Table 44. Environmental Conditions that Result from Activities Associated with the Action Alternatives.

Resultant Environmental Condition	Notes
Introduction or increase in invasive plants	
Soil disturbance	Beyond normal levels. Includes erosion, movement or removal of soil, alteration of hydrologic systems, and dust
Air pollution, including greenhouse gas emissions	Associated with machinery and other sources
Water pollution	Runoff from roads into streams, riparian areas, and wetlands
Soil compaction	
Hydrological alteration	Dams, ditches, culverts, other water-control structures
Toxicity	Includes chemical spills
Removal or damage of vegetation	Including overstory and understory trees, shrubs, or herbaceous vegetation
Alteration of successional pathways	
Removal of ground cover	Including mosses, lichens, litter and duff, gravel, stones and boulders
Soil heating	From prescribed fire
Changes in fuel quantity or quality	Physical alteration of biomass or fuels profile (increased fuels on ground)
Fragmentation or isolation of stands in landscape	Stands could be stands of trees, openings, shrub communities, or herbaceous communities

New or temporary road construction results in localized, but intense soil disturbance that leaves the road bed and banks devoid of previous vegetation. This can result in accidental removal of sensitive species or damage to individuals. This impact is most likely to affect Colorado tansy aster, narrowleaf grapefern, and peculiar moonwort, and possibly also park milkvetch as they

have the greatest potential to occur where roads may be built. Colorado tansy aster will over time re-colonize old road banks, but the Botrychium species probably wouldn't as it is not thought to be tolerant of major disturbance and the microsite requirements for this species may be too greatly altered by road construction. Depending on the time of year that treatments are conducted, negative direct impacts to undetected narrowleaf grapefern, peculiar moonwort and Colorado tansy aster individuals could also include trampling or crushing of above-ground vegetative and reproductive parts (summer to fall), or crushing the underground portions of the plant (year round) by road construction, reconstruction, or traffic. As Botrychium spend the first phase of their life completely underground, undetected individuals could be adversely directly impacted by crushing due to compaction of the soil. This impact would be reduced if treatments near known or unknown populations were over snow, although there probably would be some slight impacts if compaction was of enough magnitude to crush individuals.

Sensitive plant species could incur direct impact if broadcast burning were to consume an individual or population. Pile burning could directly impact Colorado tansy aster, narrowleaf grapefern, or peculiar moonwort by consuming individuals and killing underground portions of the plant, if the piles were constructed over individuals or populations. There is also the potential that staging areas could occur on populations of these species, which could result in injury or mortality.

Park milkvetch, lesser panicled sedge, round leaf sundew, Altai cottongrass, Chammiso's cottongrass, slender cottongrass, sageleaf willow, sphagnum moss, and lesser bladderwort could be directly affected from foot traffic that tramples individuals. This could result in injury or mortality of individuals, but light foot travel[14] is not anticipated to have more than a localized impact; heavier foot travel or travel by motorized or mechanical equipment would cause significant impacts through alteration of the water table. Most of these species grow in habitats that often have standing water or high water tables. Legal and regulatory limitations on soil-disturbing activity in these areas reduce the potential for direct impacts.

Many of the activities included in the action alternatives will result in some level of soil disturbance, ranging from negligible disturbance from walking to substantial soil disturbance caused by road construction or mechanical timber harvest equipment. The creation of bare soil from soil disturbance could result in invasion by nonnative plants or weeds or growth of pre-existing infestations, which could adversely impact all sensitive species if they were to occur near the disturbances where invasive plants occur. However, in accordance with required soul standards soil displacement and adverse compaction will not exceed 15% of a harvest unit. The changes in microclimatic conditions where there is bare or disturbed soil could impact

[14] Less than two passes on the same trail per day.

narrowleaf grapefern and peculiar moonwort from the drying of the soil, which would result in desiccation or disruption of mycorrhizal networks and deterioration of plant health. Conversely, for disturbance niche species, some benefit could occur from creation of suitable habitat.

Any amount of bare soil exposed near a fen will result in some erosion and resulting sedimentation into the fen. Sedimentation in fens can affect sensitive species indirectly, by inhibiting peat formation (D. Weixelman, pers. comm., 2014) which will ultimately result in reduced suitability of habitat and population decline. Sedimentation could also bury individuals.

Dust and other airborne material created by vehicles on roads, soil-moving equipment, mastication equipment, etc. could settle on the leaves of sensitive plant species. This could result in decreased vigor and adversely impact photosynthesis, transpiration and respiration (Farmer 1992). This impact is likely to be short-term and negligible as when the rainy season begins, the dust will be washed off. This is more likely to impact species in the units with multiple entries and those adjacent to roads. If dust abatement compounds are used (MgCl2 or CaCl2), there is the potential for toxicity to sensitive plants growing close to treated roads, resulting in reduced vigor or mortality of individuals or populations; although most studies have shown effects of dust abatement compounds to be less than effects of road dust on untreated roads. There is a design feature that will greatly reduce, if not eliminate this impact as it prohibits use of these compounds within 500’ of known occurrences or fens and wetlands.

Reduction in tree canopy will be a consequence of many of the proposed treatments, such as timber harvest, mastication, prescribed fire, removal of hazard trees, and hand thinning. The magnitude of the resulting indirect impacts depends on the amount of tree canopy reduction. Target levels of post treatment canopy cover vary depending on pre-treatment stand conditions, affected vegetation type, and prescription objectives. Resiliency treatments in spruce stands would be only partial cutting, resulting in small reductions in live canopy, while treatments in aspen stands would affect a much larger portion of the tree canopy. The effect of tree canopy reduction with prescribed fire would not be a uniform reduction across the landscape, but would occur as a mosaic with patches of tree canopy loss, and adjacent areas with no net change. More uniform patterns of tree canopy removal would result from hand and mechanical treatments, though follow up prescribed fires could result in further decreases in tree canopy.

Introduction or Spread of Invasive Plant Species

Most actions associated with project implementation have the potential to increase invasive nonnative plant species abundance and distribution. However, consistent use of design feature IW-1 thru IW-4 will significantly reduce the probability of spread through avoidance of areas having existing populations of invasive plants, proper pre-cleaning of equipment and aggressive treatment when populations are discovered. Species could be newly introduced, or there could be increases in abundance and distribution of invasive plant species that are already found within

the project area. There is the potential for adverse impacts to sensitive plants species due to invasive plant species.

Merriam et al. (2006) found that the greatest factors correlated with non-native cover and abundance is overstory canopy, litter cover, duff cover and duff depth. Where vegetation is cleared and there is little to no overstory remaining, the risk for invasions by nonnative plant species is high, though generally localized. Reducing overstory canopy allows light to penetrate to the soil surface and this, combined with reduced water and nutrient competition from the shrub layer, can allow for invasive nonnatives to increase in distribution and abundance. The removal of overstory or understory can result in increased solar radiation, which changes evapotranspiration rates and changes microclimate in the understory. This has the potential to either create or eliminate suitable habitat, depending on the species of concern. The removal of vegetation can also open areas to access by recreating public, livestock, or big game, which may result in adverse indirect impacts to sensitive species by introducing or spreading invasive plants or trampling sensitive plant individuals or habitat.

Project activities can indirectly impact sensitive plant species by facilitating invasive species through:

1. Introduction of new species to the project area, or introducing invasive species to new areas in the project area.
2. Alterations of habitat that result in the increased abundance and distribution of invasive plant species already known to occur within the area.

Invasive species impact native communities and biodiversity of native species in several ways, including changes in plant community structure and changes in native species richness and abundance. The mechanisms responsible for these changes are often poorly understood, due to the complex nature of interactions between species and the various trophic levels in a community (Levine et. al 2003). Some of the mechanisms for changes in communities include changes in the soil chemistry (salt accumulation, changes in nitrogen cycling, allelopathy[15]), changes in site and food quality and quantity for other trophic levels, changes in soil biota, changes in soil moisture, competition for resources such as light and nutrients, and changes in ecosystem processes, such as hydrologic regimes or fire regimes. Invasive plant species also impact and alter successional pathways.

Pile Burning

[15] "a biological phenomenon by which an organism produces one or more [chemicals] that influence the growth, survival, and reproduction of other organisms" (en.wikipedia.org).

Soil disturbance can result from burning piled slash. In locations where pile burning occurs, there is the potential for soil to rise to high temperatures due to increased residence time associated with concentrated fuels. The larger the pile being burned, the higher the soil heating temperatures, the deeper the heat pulse and the longer the soil will take to recover to normal temperatures (Massman et. al 2003). Depending on the size of the pile, soil heating, and residence time during burning operations, the soils below may become sterile and native seed banks will be reduced or eliminated, and can reduce soil microbial communities (Jiménez Esquilín and others 2007). Studies have found that the footprint of slash piles that have been burned can be vulnerable to invasive plants (Keeley 2006, Scherer and others 1999) which could negatively impact any sensitive species in the vicinity of burn piles. There could also be adverse impacts to narrowleaf grapefern and peculiar moonwort if there were individuals in the underground stages where the piles were burnt, or if mycorrhizal relationships were eliminated due to the intense soil heating.

Prescribed Fire

When the soil is exposed to heat, the physical, chemical and biological properties can be altered (Wohlgemuth and others 2006), and depending on fuel loading, there is a range of potential effects. Where fuel loading is high effects could be similar to that for pile burning, though more frequently there will likely be lower intensity fire. With prescribed fire, the vegetation is consumed, nitrogen and phosphorus are often made available which could adversely indirectly impact sensitive plant species and their mycorrhizal symbionts by facilitating invasion of invasive exotic plant species, but could also beneficially impact sensitive plant species, such as narrowleaf grapefern and peculiar moonwort, and their mycorrhizal symbionts in the short-term by freeing nutrients for their use (Johnson-Groh and others 2002). It has been shown that some fen species are colonized by arbuscular mycorrhizal fungi, which show a decrease in mycorrhizal colonization when phosphorus is added (Cornwell and others 2001). If phosphorus is released during fires in the vicinity of a fen, there could be a longer term adverse effect by this decrease in colonization, due to the short term increases in phosphorus availability.

Roads

Existing roads are corridors that can fragment populations and/or habitat, create dust, and spread and/or introduce invasive species. Roads result in localized soil compaction which can alter the hydrology of an area and disrupt mycorrhizal networks.

Road activities are likely the greatest contributor to invasive plant risk for this project (Bridsall and others 2012). Roads and their maintenance are comprised of areas where there is repeated soil disturbance. This disturbance creates prime suitable habitat for invasive plants to become and remain established. This is compounded by high concentrations of vectors for invasive species (vehicles, etc.). Road maintenance can also remove individual sensitive plants (or all of a

population if it occurs within road). New or temporary road construction also results in localized, but intense ground disturbance that leaves the road bed devoid of previous vegetation. This can result in impacts to mycorrhizal symbionts. This impact is most likely to affect narrowleaf grapefern and peculiar moonwort. This could result in interruptions to the mycorrhizal networks, reducing the health and vigor of populations.

Road use and construction can alter hydrologic function. Roads can divert water into a different course. Roads contribute to heightened sedimentation levels (Gucinski and others 2001) which if occurred upslope from a fen could result in sediment accumulation in the fen. As mentioned above, sediment in fen could smother sensitive plant species or result in retarded peat accumulation rates, diminishing suitable or occupied habitat health.

Mechanical Treatments

Mechanical treatments usually occur on slopes less than 40%, due to equipment limitations. Mechanical treatments in the wildland-urban interface could be on steeper slopes if access is available from an existing road. Mechanical treatments include hazard tree removal and would differ between spruce-fir and aspen vegetation types. Direct effects of mechanical treatments would be limited to sensitive species that may be found in spruce-fir or aspen stands, notably narrowleaf grapefern and peculiar moonwort.

All actions associated with mechanical treatments have the potential to introduce invasive species, or to increase the extent of existing infestations of invasive species. This would have adverse effects on sensitive plant species.

In aspen, the prescription is primarily for coppice cutting, which is a form of clearcutting. No sensitive species are known to occur in pure aspen stands, but may occur in areas that are adjacent to stands of aspen, or in mixed aspen-spruce-fir. However, most aspen stands, whether pure aspen or mixed with conifers, have abundant leaf litter. Most aspen clearcuts produce little bare soil on which weeds could invade, and what bare soil that is created is quickly covered with aspen sprouts and other vegetation. As in all vegetation types, design criteria should reduce soil disturbance to the minimum.

In spruce-fir vegetation types, prescriptions would vary, ranging from group selection treatments (small patch cuts) to uneven age harvesting (selected individuals cut). There is the potential for the promotion of invasive plant populations due to reduced canopy cover, soil compaction altering hydrologic regimes, or soil disturbance resulting in exposed soil that could erode downhill.

Heavy machinery can substantially disturb the soil, especially tracked machinery typically used to construct or rebuild roads. “Although other forest management activities usually occur on a

larger proportion of the landscape, the erosion rates on roads are the dominant source of sediment in most managed forests" (Robichaud and others 2010). Soil disturbance can result in creation of suitable habitat for invasive plants, increases in erosion, alteration of the microtopography of the soil (changing the pathway of water), and disruption of mycorrhizal networks. Heavy machinery can also result in soil compaction which could alter surface and subsurface hydrologic flow or disrupt mycorrhizal networks. If a fen occurred in the same small watershed as extensive soil disturbance, surface erosion or disruption of groundwater could occur, resulting in impairment of functions of the fen.

A study conducted in the Colorado Front Range found that when chipping treatments were conducted, if a layer of woodchip was left in place, there was a reduction in understory growth (Wolk and Rocca 2009). Another study in the Front Range found no erosion in stands where chipping residue had been left (reported in Robichaud and others 2010). This effect would be beneficial if the woodchip reduced the potential for invasive plant establishment, but adverse if it smothered sensitive plant populations.

If timber harvest treatments result in high levels of aspen regeneration (possible in both aspen and spruce-fir-aspen mix) there is the potential for increased browsing from native ungulates and domestic grazers, which could cause more soil exposed and increase the likelihood of invasive plants.

Replanting and preparatory activities for replanting may occur in spruce-fir, especially where the stand is mostly dead from spruce beetles or other factors. Preparing the sites for replanting can involve soil disturbance, especially if scarification of the soil is used. This could result in disruption to mycorrhizal symbionts for narrowleaf grapefern and peculiar moonwort. There is also the potential for introduction of invasive plants.

Staging Areas and Landings

There will likely be high levels of soil disturbance and potentially soil compaction in staging areas and landings. The high levels of disturbance in these sites make them vulnerable to invasive plant introduction and proliferation. The introduction of invasive species at these sites has a high potential for adverse indirect impacts to sensitive species if present. This impact will be reduced by design features that require invasive plant surveys and treatment.

Cumulative Effects Common to All Action Alternatives

There are a number of Forest Service and other activities in the vicinity of the proposed alternatives that have the potential to result in cumulative impacts when combined with the impacts associated with the proposed vegetation treatments.

displays the foreseeable actions that contribute cumulatively to impacts to sensitive species and their suitable habitat, and whether the impacts are anticipated to be similar to those described above in the effects analysis.

Table 45. Present and Future Projects and Activities in the Cumulative Impacts Analysis Area.

Agency	District	Foreseeable Future Project	Impacts within the range of those described in direct and indirect impact (Yes/No) and effects analysis and additional comments.
USDA Forest Service	Forestwide	Ongoing Grazing Activities	No, see below
	Gunnison	Cochetopa Hills Vegetation management	Yes, Design Features included to mitigate impacts to Colorado tansy aster, narrowleaf grapefern and peculiar moonwort.
	Grand Valley	Mesa Point Fuels treatments	Yes
	Norwood	Naturita Fuels	Yes. Includes invasive plant treatments in project design.
	Ouray	Owl Creek Road Maintenance	Yes.
	Grand Valley	Trickel Park Road Road improvements and maintenance	Yes.
	Forestwide, multiple locations	Trail Management	Yes, similar to impacts from roads though greatly reduced.
	Grand Valley	Resort Mesa treatments	Yes
	Ouray	Escalante Forest Restoration treatments	Yes
	Gunnison	La Garita salvage treatments	Yes
USDI BLM	Gunnison Field Office	Gunnison Spruce Beetle Response	Yes
Private landowners	N/A	Grazing	No, see below

The following is a brief summary of the potential range of impacts anticipated from the activities mentioned in the above table. These descriptions summarize the general potential indirect impacts through the pathway of changes to environmental conditions (e.g. increases in invasive species in the cumulative impacts analysis area, climate change, etc.).

Vegetation Management and Fuels Reduction Projects

There are four upcoming Forest Service vegetation management projects that will occur in the cumulative impacts analysis area. The vegetation and fuels reduction projects involve vegetation treatment similar to those proposed in the action alternatives for this project, and thus direct and

indirect impacts on site are similar to those assessed in this report. Conducting many projects across the landscape in close temporal and geographic proximity is likely to result in the effects described in this analysis being greater.

Grazing

Grazing, both on and off Forest Service lands, has the potential to add to the effects for all species. Grazing has been identified as potentially impacting sensitive fen species, park milkvetch, and potentially Colorado tansy aster. The impacts caused by grazing include trampling, browsing, and impacts in fens to hydrologic function and peat formation from hoof punches. This activity would interact with the proposed action alternatives by further decreasing the vigor of populations.

Invasive Plants

The continued introduction and spread of invasive plants will act with the proposed alternatives to decrease habitat suitability and increase competition for resources where they co-occur with sensitive plants. Continued invasive plant management would be a beneficial impact for sensitive plants, reducing impacts from invasive plants. Please see the Noxious and Invasive Weeds section in this EIS and the Invasive Plant Risk Assessment located in the project record for a full discussion of the anticipated impacts.

Recreational Activities

There has been a strong trend for several decades towards more recreation on National Forests. Although not due to actions from this EIS, we can expect more pressure on roads and trails, and more demand for off-road vehicle use. As a result, more invasive plant species will become introduced, and existing infestations could get larger due to spread by recreationists. There is also the potential for fen species to be impacted from illegal vehicular trespass, creating changes in hydrology.

Road Maintenance by State and County

County road maintenance was identified as a potential cumulative effect for Machaeranthera coloradensis, narrowleaf grapefern, and peculiar moonwort. There are known populations of Machaeranthera coloradensis occurring along county maintained roads. County road maintenance could result in additional impacts to individuals such as crushing, or removal by road maintenance equipment. This would act synergistically with the proposed action to add to the potential for decreased vigor and increased mortality of individuals, and could eradicate populations near or adjacent to roads where impacts could occur.

Comparison of Alternatives

All action alternatives propose to treat the same maximum amount of acres (120,000), since treatment is a function of Forest budget and planning capacity. The key difference between the action alternatives are the "opportunity areas" or where the treatments could occur. Between action alternatives, the opportunity areas increase in area from Alternative 3 to Alternatives 2 and 4. The key distinguishing factor is treatment location; this will determine whether there are sensitive plant populations in the area and what activity type is utilized for implementation. This means the potential for difference in impacts between alternatives could vary from no difference in impacts to a more substantial difference. Table 46 attempts to capture the potential for differences.

Table 46. Comparison of Alternatives.

Comparative descriptor	Alternative 1	Alternative 2	Alternative 3	Alternative 4
General description	No actions with this alternative. Potential for passive indirect effects.	Proposes maximum of 120,000 acres of aspen and spruce resiliency and recovery treatments over approximately 718,000 acres.	Proposes maximum of 120,000 acres of aspen and spruce treatments in WUI[1] over approximately 426,000 acres.	Proposes maximum of 120,000 acres of aspen and spruce (salvage only) treatments over approximately 718,000 acres.
Sizes of opportunity areas	No actions.	Approximately 718,000 acres. Moderate hydrologic and soil impacts possible, spread over large area.	Approximately 426,000 acres. Treatments in more concentrated area (WUI[1]) compared with other action alternatives potentially resulting in greater hydrologic and soil impacts in a smaller, highly-visible area.	Approximately 718,000 acres. Same as 2.
Invasive species	No actions.	Moderate use of mechanical treatment, moderate risk for introduction or spread of invasive plants. Potential for introduction and spread of invasive plants due to increased vectors.	Area of treatment with highest concentrations of invasive plants, local introductions the greatest risk. Higher risk of introduction with higher road maintenance. Would occur primarily in areas that already have the highest infestations, making it more likely invasive plants would be spread.	Increases commerical opportunity acres available for treatment but the projected acres to be treated over the life of the project remains the same. All commercial mechanical treatments in spruce will be recovery (salvage or sanitation) and therefore pose a greater risk of soil disturbance in treatment units. Higher potential for ground disturbance does pose a higher risk for introduction of invasive plants.

Comparative descriptor	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Environmental Baseline	No actions.	Second largest footprint for commercial opportunity areas. With the exception of invasive plant introduction, could have fewest impacts due to dispersed application of treatments.	Footprint of opportunity area would occur in areas that have generally experienced the greatest ongoing habitat alterations (development) and would have the smallest change from environmental baseline to post implementation environment.	Largest footprint for commercial opportunity area. With the exception of invasive plant introduction, could have fewest impacts due to dispersed application of commercial treatments.
Fen Wetlands[16]	No actions.	Has the potential to include fens or other wetlands.	Would include the fewest number of fens or other wetlands, and hence would likely adversely impact the sensitive species known from fens the least.	Has the potential to include the greatest number of fens and other wetlands in commercial treatments, given spuce treatments would be salvage only. Commercial mechanical treatment is restricted to suitable timber lands which is on slopes <40% which increases the chance for conflict with fens and wetlands which occur on shallower slopes.
Roads	No actions.	Maximum potential estimate of 260 miles temporary roads, 60 miles designed roads, 260 miles reconstructed roads, 440 miles road maintenance. High dispersal of road impacts due to larger affected landscape, though resulting in the introduction or spread of invasive plants.	Maximum potential estimate of 70 miles temporary roads, 10 miles designed roads, 260 miles reconstructed roads, 660 miles road maintenance. Highest concentration potential for road activities.	Same as 2. Highest potential for dispersal of road impacts due to larger affected landscape for commercial treatments, though resultant in the potential spread of invasive plants (see above).

[16] Findings based on statistical analysis of data in the 2012 GMUG Fen Inventory (Johnston and others 2012).

Alternatives 2 and 4 – Direct and Indirect Effects

The effects from Alternative 2 and 4 are within the range of alternatives described in the direct, indirect and cumulative effects discussed under Direct and Indirect Effects Common to all Action Alternatives.

The actual impacts and effects to sensitive species will depend on where the treatments occur. The potential for impacts could be dispersed due to the larger ratio of treatment per area (that is, more acreage to spread the treatments within), resulting in potentially less direct and indirect effects. These alternatives offer the larger number of acres to plan treatments in, which could have the least amount of impacts to sensitive species. Conversely, there is also the potential for greater effects from invasive plant spread as this alternative has the potential to treat the same number of acres across a larger landscape, which could result in invasive species being introduced into the greatest amount of uninfested areas.

Because Alternative 4 limits spruce-fir treatments to recovery treatments only, these could result in increased ground disturbance and therefore increased chance of surface erosion, and consequently, a higher potential for sedimentation in fens and other impacts associated with erosion. Fens are frequently located in areas with slopes less than 40%, so there is the potential for greater conflict of treatment placement and effects to fens and their sensitive species with this alternative.

The following is a description of the more likely effects per species. Effects discussed assume all applicable design features have been implemented on the project as designed.

Park Milkvetch

Potential for direct impacts to park milkvetch under Alternative 2 include direct injury, or mortality of individuals. This would occur if the population was growing in a “subriparian swale” or other mesic site not identified for protections based on design features protecting wetlands and meadows. However, surveys should detect populations prior to project implementation and flag and avoidance measures could be followed to protect individuals and populations. This species is rhizomatous which could allow for reestablishment to pre-disturbance levels if only individuals were damaged.

Park milkvetch could be adversely indirectly impacted by any action that resulted in changes to hydrology or sedimentation from above, affecting the suitability of its microsite conditions. Park milkvetch could also be adversely indirectly impacted by the introduction and spread of invasive species resulting in increased competition. Park milkvetch could also be adversely indirectly impacted if browsing were to increase due to increases in aspen sprouting in the vicinity of a population. All these indirect effects could result in reduced vigor of the population, reduced habitat for the species and the potential mortality of individuals.

Narrowleaf Grapefern and Peculiar Moonwort

Narrowleaf grapefern and peculiar moonwort can remain dormant underground for many years, and it has even been shown that the below-ground to above-ground ratio can be very high (Johnson-Groh and others 2002). This would make individuals undetectable during field surveys and so design features would not be implemented. This could result in individuals or populations being burned under piles, removed and killed during road construction or desiccated during overstory removal, resulting in the loss of either individuals or entire populations. These same impacts could also result in decreases in individual or population vigor, though it has been observed that the above ground portions are fairly resilient to light disturbance.

The greatest adverse indirect impact to narrowleaf grapefern and peculiar moonwort could be impacts to the mycorrhizal symbiont. The greatest impacts to mycorrhizal are likely to occur with actions that intensely affect soil and microbial structure and communities. These actions include burn piles, road construction, use of heavy machinery, and skid trails. Another factor of concern is removal of protective canopy for these individuals (*Botrychium* are sometimes only 20-30 cm tall) by timber harvest or revegetation activities. The magnitude of impacts to narrowleaf grapefern and peculiar moonwort depend on the magnitude of the impacts to the mycorrhizal symbiont. There are design criteria that prevent more than 15% of the soil in a treatment area from being severely burned, compacted, eroded and displaced. This would likely reduce the severity of impact, though may not fully mitigate all potential negative effects and therefore somereduced vigor in individuals or populations could occur. Narrowleaf grapefern and peculiar moonwort could also be adversely indirectly impacted by the introduction and spread of invasive species resulting in increased competition, and could also experience indirect effects from toxicity, especially if they are in the gametophytic underground phase, and dust abatement or herbicide were applied directly or in the near vicinity. This could result in reduced vigor or mortality in some individuals or populations. Indirect effects could arise from changes in canopy cover of associated vegetation due to removal of overstory trees. A decrease in canopy cover may temporarily create habitat for narrowleaf grapefern, peculiar moonwort and Colorado tansy-aster by increasing sunlight. Creation of temporary habitat could be beneficial to individuals, but transient habitat seems marginally beneficial on a population level.

Lesser Panicled Sedge, Round Leaf Sundew, Altai Cottongrass, Chammiso's Cottongrass, Slender Cottongrass, Sageleaf Willow, Sphagnum Moss, and Lesser Bladderwort

Design features for this protect these species from direct effects, all known to occur in fens and occasionally other wetlands, unless personnel were to walk out into a fen or wetland and crush an individual.

Indirect impacts to lesser panicled sedge, round leaf sundew, Altai cottongrass, Chammiso's cottongrass, slender cottongrass, sageleaf willow, sphagnum moss and lesser bladderwort would

result from impacts to their habitat. The primary impacts would include sedimentation and alterations to hydrology of the fens or wetlands. Design features have been included to limit the effects of these impacts, but there is still the potential to some degree that fens could experience some sedimentation and alteration of hydrology. These effects may be minor, short term influences to fen function, but could result in long term effects that alter to some extent the vigor of these species populations.

Colorado Tansy Aster

There could be direct effects to Colorado tansy aster from road reconstruction and hauling. Road reconstruction could include widening the road prism, vegetation clearing, installing drainage structures and suitable water crossings, and applying road surfacing. Scraping and reconstructing these roads would directly impact Colorado tansy-aster plants growing in road beds. Individual plants could also be adversely impacted by being repeatedly driven on or parked on. The result would likely be loss of the plants growing in road beds subject to improvement, and a few plants would have reduced vigor or mortality in parking areas. There is also the potential for mortality caused by piles being constructed and burned on a population.

Road activities could result in indirect impacts to Colorado tansy aster from dust, dust abatement, and invasive plant spread. Dust could reduce the photosynthetic capacity of individuals or parts of populations. Dust abatement could result in mortality of individuals, though a design feature that limits application of the harmful dust abatement compounds within 500 feet of known populations greatly reduce the potential for this impact. Invasive species may spread due to project- related activities resulting in increased competition. This indirect impact is not anticipated to be great with project implementation.

Alternatives 2 and 4 – Cumulative Effects

Park Milkvetch

Increased recreational use of the national forests, especially increased off-road vehicle use, is likely to impact park milkvetch. Other factors include ongoing grazing on and off federal lands and invasive species. Park milkvetch is known to exist in habitats (lower elevation riparian) where both these impacts occur. The effects from the SBEADMR project are not likely to affect much of the known range and suitable habitat for this species, but there may be long-term adverse impacts that could act synergistically with the cumulative effects resulting in some decline for this species.

Narrowleaf Grapefern and Peculiar Moonwort

There is only one population of peculiar moonwort and three populations of narrowleaf grapefern known in the planning area. Peculiar moonwort is thought to be sensitive to extirpation

through this part of its range (Farrar and Popovich 2012) and narrowleaf grapefern is considered to be one of the rarest vascular plants in Colorado (Beatty and others 2003). This influences the sensitivity of these species to any and all impacts to populations in the planning area to a loss of viability. There are no known threats to the known populations at this time, but one population of peculiar moonwort is known from a ski resort. Narrowleaf grapefern is known primarily from road sides that, though undisturbed at the time of location, could be vulnerable to road maintenance, vehicular activity, private timber activities, other Forest Service vegetation management projects and invasive plant spread. However, under SBEADMR only a small percentage of the mesic conifer forest cover type is proposed to be treated (<10%) so while impacts may occur they are not believed to be significant enough to result in a loss of viability at the cover type scale across the Forest.

Lesser Panicled Sedge, Round Leaf Sundew, Altai Cottongrass, Chammiso's Cottongrass, Slender Cottongrass, Sageleaf Willow, Sphagnum Moss, and Lesser Bladderwort

These fen and wetland species may be affected by climate change, especially warming of their fen and wetland habitats and less consistent patterns of precipitation. These species have specific hydrologic habitat requirements and could be indirectly impacted by changes to hydrological processes resulting from roadwork done by the county. This was not found to be a substantial impact in the GMUG fen inventory and assessment (Johnston and others 2012), but because there are 2,591 acres of potential fens in the vicinity of roads there is the potential for road use, improvement and maintenance contributing synergistically to cumulative impacts to the hydrologic function of fens. Many of these species are thought to be Pleistocene relics disjunct from cooler habitats already at the edge of their range, so climate change may be a substantial effect that is influencing the viability of these species.

Colorado Tansy Aster

County road maintenance was identified as a potential cumulative effect for Colorado tansy aster. County road maintenance could result in additional impacts to individuals such as crushing, or removal from road maintenance equipment. Livestock grazing is another ongoing activity in Colorado tansy-aster habitat. The effects of grazing on Colorado tansy-aster are probably minimal because it is apparently unpalatable to livestock and prefers habitats that are sparsely vegetated and rocky, which are not preferred for grazing (Beatty et al. 2004). Colorado tansy aster may also be cumulatively impacted by invasive plants and recreational activities (trail use, road use). This would act synergistically with the proposed action to add to the potential for decreased vigor and mortality of individuals, but is not anticipated to extirpate any of the populations as they are dispersed both along the road where impacts could occur, and adjacent to the road where fewer impacts are anticipated.

Alternative 3 (Public Safety) – Direct and Indirect Effects

Alternative 3 proposes 120,000 acres of aspen and spruce fir resiliency and recovery only within the WUI and along roads. These activities are also included in Alternatives 2 and 4. This alternative has the potential for the greatest concentration of effects as it has the highest potential for treatment per area ratio. This would mean higher concentrations of temporary roads, road reconstruction activities, mechanical treatments, and other ground disturbing activities. This could result in the greatest magnitude of impacts associated with the proposed action, though the actual effects could be lower than with the other action alternatives as there is the least amount of suitable habitat for all species considered in this alternative.

Alternative 3 has the greatest overlap and potential treatment intensity with known invasive plant populations and with already altered baseline habitat. This means that there is the greatest probability of invasive plant spread, but there may be fewer impacts to sensitive species and their habitat associated with the increases in invasive species due to their already being present, and the suitable habitat for sensitive species already being potentially in compromised condition due to human activities associated with the WUI.

Park Milkvetch

Direct effects are anticipated to be within the range of those discussed in Alternatives 2 and 4.

Indirect effects are anticipated to be within the range of those discussed in Alternatives 2 and 4.

Narrowleaf Grapefern and Peculiar Moonwort

Direct effects are anticipated to be less than those discussed in Alternatives 2 and 4. The lower number of temporary roads and road reconstruction miles will likely reduce the potential for adverse direct impacts to individuals and populations.

Indirect effects are anticipated to be less than those discussed in Alternatives 2 and 4. The lower number of temporary roads and road reconstruction miles will likely reduce the potential for adverse indirect impacts to individuals and populations.

Lesser Panicled Sedge, Round Leaf Sundew, Altai Cottongrass, Chammiso's Cottongrass, Slender Cottongrass, Sageleaf Willow, Sphagnum Moss, and Lesser Bladderwort

Direct effects are anticipated to be within the range of those discussed in Alternatives 2 and 4.

Indirect effects to lesser panicled sedge, round leaf sundew, Altai cottongrass, Chammiso's cottongrass, slender cottongrass, sageleaf willow, sphagnum moss and lesser bladderwort may be slightly lower with Alternative 3, though the densities of activities—if restricted to the WUI – will only impact slightly fewer potential fens and potential fen acres. The increases in

concentrations of these activities may lead to greater levels of sedimentation and hydrologic alteration, though adherence to design features will reduce the potential for substantial long term impacts to the viability of these species.

Colorado Tansy Aster

Direct effects are anticipated to be less than those discussed in Alternatives 2 and 4. The lower number of temporary roads and road reconstruction miles will likely reduce the potential for adverse direct impacts to individuals and populations.

Indirect Impacts

Indirect effects are anticipated to be less than those discussed in Alternatives 2 and 4. The lower number of temporary roads and road reconstruction miles will likely reduce the potential for adverse indirect impacts to individuals and populations.

Alternative 3 – Cumulative Effects

Park Milkvetch

Cumulative effects are anticipated to be within the range of those discussed in Alternatives 2 and 4.

Narrowleaf Grapefern and Peculiar Moonwort

Cumulative effects are anticipated to be less than those discussed in Alternatives 2 and 4. The lower number of constructed and reconstructed road miles will likely reduce the potential for adverse cumulative impacts to individuals and populations.

Lesser Panicled Sedge, Round Leaf Sundew, Altai Cottongrass, Chammiso's Cottongrass, Slender Cottongrass, Sageleaf Willow, Sphagnum Moss, and Lesser Bladderwort

Cumulative effects are anticipated to be slightly less than those discussed in Alternatives 2 and 4.

Colorado Tansy Aster

Cumulative effects are anticipated to be in the range, though less than those discussed in Alternatives 2 and 4. The lower number of constructed and reconstructed road miles will likely reduce the potential for adverse cumulative impacts to individuals and populations.

Determinations of Effect and Rationale by Alternative

All alternatives are in compliance with the Endangered Species Act (ESA). There are no impacts or effects to Threatened and Endangered Plant Species and all proposed alternatives occur outside of the known distributional and/or elevation ranges for any listed or proposed plant

species associated with these habitats. A Biological Assessment and Biological Evaluation have been conducted and are available in the project record.

Alternative 1 (No Action) – Direct and Indirect Effects

There are no proposed management activities under Alternative 1. There is the potential for indirect effects resulting from natural processes. There will be no direct effects on *lesser panicled sedge, round leaf sundew, Altai cottongrass, Chammiso's cottongrass, slender cottongrass, sageleaf willow, sphagnum moss, lesser bladderwort, park milkvetch, Colorado tansy aster, narrowleaf grapefern* and *peculiar moonwort* from the implementation of the No Action Alternative. Alternative 1 complies with Regional policy on sensitive species as there is no effect.

Alternative 1 (No Action) – Cumulative Effects

There is no action associated with Alternative 1. Though there is the potential for passive indirect effects, there is no action so it is determined that Alternative 1 will have **no cumulative effect** on *lesser panicled sedge, round leaf sundew, Altai cottongrass, Chammiso's cottongrass, slender cottongrass, sageleaf willow, sphagnum moss, lesser bladderwort, park milkvetch, Colorado tansy aster, narrowleaf grapefern* and *peculiar moonwort.* Alternative 1 complies with Regional policy on sensitive species as there is no effect.

Alternative 2 (Proposed Action) –Direct and Indirect Effects

Alternative 2 complies with Regional policy (FSM 2670.32) as pre-implementation surveys will be conducted and design features have been designed to reduce and minimize the potential effect to the viability of these species and their habitat, to the extent possible consistent with project goals.

There is a potential for direct and indirect impacts to sensitive plants that grow in fens, including the *lesser panicled sedge, round leaf sundew, Altai cottongrass, Chammiso's cottongrass, slender cottongrass, sageleaf willow, sphagnum moss, lesser bladderwort,* and *park milkvetch.* Habitat altering prescriptions that will occur in the proximity of fens could result in altered habitat conditions or damage to individual(s) or populations. While this potential exists, the detailed design criteria that protect their habitat (wetlands and fens) mitigate much of the risk to these species. Thus, the determination for these species is that the action alternatives **may affect individuals, but is not likely to result in a trend toward Federal listing or loss of viability** of affected species.

There is the potential for direct and indirect impacts for *narrowleaf grapefern* and *peculiar moonwort* due to the potential for widespread impacts to undetectable individuals and their suitable habitat that cannot be mitigated through design features. However, since a relatively small percentage of the mesic forest cover type will be affected at the Forest scale (<10%) and

avoidance of populations when they are detected, assuming the worst case scenario with implementation of Alternative 2, a determination of alternatives **may affect individuals, but is not likely to result in a trend toward Federal listing or loss of viability** of *narrowleaf grapefern* and *peculiar moonwort*.

There is the potential for direct and indirect impacts for *Colorado tansy aster,* based on the species occurring on road systems and adjacent to areas that could be impacted. Design features have been included in project design that reduce the impacts from road use and destruction of populations due to staging areas and pile burning. Thus, a determination that implementing Alternative 2 **may adversely impact individuals, but is not likely to result in a loss of viability on the planning area, nor cause a trend to federal listing or a loss of species viability**.

Alternative 3 (Public Safety) – Direct and Indirect Effects

Alternative 3 complies with Regional policy (FSM 2670.32) as pre implementation surveys will be required and design features have been designed to reduce and minimize the potential effect to the viability of these species and their habitat, to the extent possible consistent with project goals.

There is a potential for direct and indirect impacts to all sensitive plants analyzed in this document including *lesser panicled sedge, round leaf sundew, Altai cottongrass, Chammiso's cottongrass, slender cottongrass, sageleaf willow, sphagnum moss, lesser bladderwort, park milkvetch, Colorado tansy aster, narrowleaf grapefern* and *peculiar moonwort.* Design features are included in the project design to mitigate the impacts to all sensitive plants. Alternative 3 has a smaller footprint of where impacts would occur, and hence potentially affects a smaller portion of the range for all sensitive plants. Thus, it is determined that implementing Alternative 3 **may adversely impact individuals, but is not likely to result in a trend toward Federal listing or loss of viability**.

Alternative 4 (Spruce Salvage) – Direct and Indirect Effects

Alternative 4 complies with Regional policy (FSM 2670.32) as pre implementation surveys will be required and design features have been designed to reduce and minimize the potential effect to the viability of these species and their habitat, to the extent possible consistent with project goals.

There is a potential for direct and indirect impacts to sensitive plants that grow in fens, including the *lesser panicled sedge, round leaf sundew, Altai cottongrass, Chammiso's cottongrass, slender cottongrass, sageleaf willow, sphagnum moss, lesser bladderwort,* and *park milkvetch.* Habitat altering prescriptions that will occur in the proximity of fens could result in altered habitat conditions or damage to individual(s) or populations. While this potential exists, the

detailed design criteria that protect their habitat, wetlands and fens mitigate much of the risk to these species. Thus, the determination for these species is that the action alternatives **may affect individuals, but is not likely to result in a trend toward Federal listing or loss of viability** of affected species.

There is the potential for direct and indirect impacts for *narrowleaf grapefern* and *peculiar moonwort* due to the potential for widespread impacts to undetectable individuals and their suitable habitat that cannot be mitigated through design features, though design features that protect observed populations are included in project design. Thus, assuming the worst case scenario with implementation of the Alternative 4 a determination of alternatives **may affect individuals, but is not likely to result in a trend toward Federal listing or loss of viability** is made.

There is the potential for direct and indirect impacts for *Colorado tansy aster,* based on the species occurring on road systems and adjacent to areas that could be impacted. Design features have been included in project design that reduce the impacts from road use and destruction of populations due to staging areas and pile burning. Thus, it is determined that implementing Alternative 4 **may adversely impact individuals, but is not likely to result in a loss of viability on the planning area, nor cause a trend to federal listing or a loss of species viability**.

Cumulative Effects Common to All Action Alternatives

The indirect effects of natural processes in combination with past, ongoing, and future activities could result in cumulative effects on the species listed in the Direct and Indirect Effects analyses for each of the action alternatives.

Noxious and Invasive Weeds

The GMUG utilizes the Colorado state noxious weed list to guide management on invasive plants, and additionally manage for invasive species of local concern. The State of Colorado Department of Agriculture ranks invasive plant species by their priority for treatment (CDA 2013).

Existing information on the GMUG for invasive species shows them primarily concentrated along roadways, in campgrounds, along power lines, and other areas with high levels of existing disturbance factors. It was found that these areas also correspond with existing infestations of priority management species. In the analysis conducted for this report, comparison factors found in the literature to be closely associated with invasive species spread (canopy cover, ground disturbance and propagules pressure) are used as a proxy for increased risk of spread associated with project activities. There is a measure of uncertainty in precisely how invasive species will

continue to expand and invade the existing environment given the complex interactions and factors that influence densities and distribution, so projections are qualitative instead of quantitative.

Compliance with Regulatory Direction

Federal Laws and Regulations

The principal statutes governing or supporting the management of aquatic and terrestrial invasive species on the National Forest System include but are not limited to, the following statutes. Except where specifically stated, these statutes apply to the entire National Forest System.

- Organic Administration Act of 1897 (16 U.S.C. §§473 *et seq*.).
- Bankhead-Jones Farm Tenant Act of 1937 (7 U.S.C. §§1010 *et seq*.) Title III of the Act.
- Anderson-Mansfield Reforestation and Revegetation Act of October 11, 1949 (16 U.S.C. 581j (note), 581j, 581k).
- Sikes Act (Fish and Wildlife Conservation) of September 15, 1960 (16 U.S.C. 670g-670l, 670o, P.L. 86-797), as amended. Section 201.
- Appropriations Resolution, 2003. Section 323 of the Act, codified at 16 U.S.C. 2104.
- The Plant Protection Act of 2000 (7 U.S.C. 7701 et seq) as amended by the Noxious Invasive Plant Control and Eradication Act of 2004 (P.L. 108-412).
- Wyden Amendment (P.L. 109-54, Section 434).
- Clean Water Act of 1977 (33 U.S.C. 1251, 1254, 1323, 1324, 1329, 1342, 1344; 91 Stat. 1566).
- National Environmental Policy Act of 1969 (16 U.S.C. 4321).
- Executive Order 13112 (Clinton 1999), Section 2.

State Laws and Regulations

Following national Forest Service policy, (Forest Service Manual 2903 p15-16) many programs and projects involving invasive plants on the GMUG are done in cooperation with the state of Colorado or one or more of its counties. Plant species on the state of Colorado's noxious weed list are shown in Appendix A of the Invasive Plant Risk Assessment Report in the Project Record.

In this report, the term *invasive plant species* will be used to describe non-native plants that meet the definition of *invasive species* in Executive Order 13112 (Clinton 1999).

Forest Service Policy and Direction

Forest Service policy states, "Management activities for aquatic and terrestrial invasive species (including vertebrates, invertebrates, plants, and pathogens) will be based upon an integrated pest management approach on all areas within the National Forest System, … prioritizing prevention and early detection and rapid response actions as necessary" (USDA Forest Service 2011d) and goes on to define five objectives:

- Prevention
- Early Detection and Rapid Response (EDRR).
- Control and Management
- Restoration
- Organizational Collaboration

Additional policy statements on invasive plants can be found in Forest Service Manual 2900, Invasive Species Management (USDA Forest Service 2011d), the National Strategy and Implementation Plan for Invasive Species Management (2004), and the USFS Guide to Noxious Invasive Plant Prevention Practices (2001).

Finally, the GMUG Forest Plan (1991 revision), includes the following goals:

- Manage vegetation in a manner to provide and maintain a healthy and vigorous ecosystem resistant to insects, diseases, and other natural and human causes.
- Increase or improve wildlife habitat diversity.
- Improve fisheries habitat.
- Protect the water quality in streams, lakes, riparian areas, and other water bodies.
- Conserve soil resources.
- Maintain long-term land productivity.

The Range Resource Management section of the 1991 Forest Plan sets a priority for treatment of noxious weeds. In the Soil Resource Management section, it sets a goal to "Maintain soil productivity, minimize man-caused soil erosion, and maintain the integrity of associated ecosystems;" and also states:

"Revegetate all areas, capable of supporting vegetation, disturbed during road construction and/or reconstruction to stabilize the area and reduce soil erosion. Use less palatable plant species on cuts, fills, and other areas subject to trampling damage by domestic livestock and big game to discourage grazing by herbivores."

All alternatives are in compliance with policy as set forth in Executive Order 13112 and FSM 2900 through the use of design features that help prevent the introduction of invasive plants and provide a mechanism for monitoring and control.

Analysis Methodology

There are several factors that are identified as increasing the risk of spread of invasive plants, including the presence or absence of an invasive plant, the type of invasive plant, inherent vulnerability of existing habitat, existing vectors facilitating invasive plant spread, and project dependent increases in these vectors and the alteration of the habitat. These factors are divided into two categories for analysis purposes; those independent of project activities, and those that are dependent on project activities.

These factors work synergistically to facilitate invasion of invasive plants. The degree of risk is qualitatively described as low, moderate or high. *Low risk* means that there is a small or negligible chance that an invasive species will spread and infest new areas or increase the size of existing infestations. *Moderate risk* means that it is likely that invasive species infestations will increase significantly in size or number of infestations, possibly up to a 50% increase with localized effects. *High risk* means that it is very likely that invasive species infestations will undergo substantial increases, and result in landscape scale effects.

Assumptions

- There is a risk of invasive species spread by vehicles, equipment and people associated with project implementation. Risk will be minimized by design features to wash and clean vehicles and remove seed from clothing; despite best intentions to remove all seed and propagules, some probability of seed and propagule spread remains due to ongoing recreation use, animal migrations, the prevalence of invasive species impacts in the proposed treatment areas, and the presence of dispersal vectors.
- Decreasing tree canopy and soil disturbing activities associated with the use of heavy equipment are key environmental factors in invasive plant species increases.
- Design features will reduce the potential introduction, spread, and establishment of invasive plants that could occur as a result of treatments.
- Individual design features may, or may not be effective at reducing the potential for introduction and spread of invasive plants. Pre-treatment planning will establish which features are necessary for treatment-specific conditions and activity types, and may require multiple features to be effective.
- The action alternatives include areas common to all; where these alternatives overlap, the impacts and effects will be similar.
- Effects will be dependent on the locations where the treatments occur, and whether there are invasive plants present.

Methods Used to Determine Factors Independent of Treatment Implementation

This portion of the analysis considers three components to risk that help define the condition of the affected environment:

1. The invasibility of each nonnative plant species and their management priority;
2. The invasibility of the landscape; and
3. The existing potential for spread (vector potential).

The methodology used to establish the baseline conditions include: invasive plants on the GMUG and their management priority; habitat vulnerability; and vector potential.

Treatment-dependent vectors: The treatment-dependent vectors considered in this analysis include all people, machines and vehicles that are used in or near the affected area for treatment planning and implementation.

Treatment-dependent habitat alterations: Treatment-dependent factors may include: changes to tall canopy cover, soil disturbance, changes in soil cover, changes in soil characteristics, changes to ground water, changes to surface water, removal or rearrangement of features storing carbon, and changes to site microclimates.

Affected Environment

Effects caused by invasive plants include altered fire patterns and intensity and resulting ecosystem changes, soil erosion and changes in nearby aquatic habitat (Lacey et al.,1989, Carpenter et al. 2000). Many non-native plant species provide poorer habitat for wildlife species and livestock than their displaced native counterparts, and some species like St. Johnswort, Russian knapweed and leafy spurge are toxic to livestock.

Invasive species impact native plant communities and biodiversity in several ways, including changes in plant community structure that result in changes in native species richness and abundance. Some mechanisms for changes in communities include:

- Changes in soil chemistry, such as salt accumulation, changes in nitrogen cycling, or allelopathy[17]
- Changes in soil biota
- Changes in soil moisture

[17] "A biological phenomenon by which an organism produces one or more biochemicals that influence the growth, survival, and reproduction of other organisms. These biochemicals are known as allelochemicals and can have beneficial or detrimental effects" (en.wikipedia.org).

- Changes in habitat and nutrition quality and quantity for producers (green plants) or consumers (wildlife)
- Changes in competition patterns for resources such as light and nutrients
- Changes in ecosystem processes, such as hydrologic regimes, decomposition rates or natural fire frequencies

Invasive plant species can impact soil biota and nutrient cycling in several ways. They can increase or decrease available nitrogen as has been observed in areas invaded with annual grasses (Levine et al. 2003). Some invasive species, such as annual grasses, have shallower root systems than species native to a site, which can result in increased soil erosion (Bossard et al. 2000). Increased biomass inputs to the litter layer may also occur, altering resource cycling. Changes to soil microbes, including fungi, bacteria, and invertebrates, can impact native communities by altering important symbiotic relationships and changing nutrient cycling.

Invasive species can impact hydrologic regimes by altering sedimentation rates, changing transpiration timing and rates, and altering erosion rates. This results in changes in flooding patterns and riparian community structure (Levine and others 2003, Bossard and others 2000).

From 1998-2013, the GMUG had inventoried or treated 34 non-native invasive plant species. The priority species for the GMUG are calculated in Appendix A of the Invasive Plant Risk Assessment Report located in the project record and summarized in Table 47.

Table 47. Priority Invasive Plant Species for the Grand Mesa-Uncompahgre-Gunnison National Forests.

Priority Class	Code	Name	Common Name
I	CIAR4	*Cirsium arvense*	Canada thistle
	CANU4	*Carduus nutans*	musk thistle
	PORE5	*Potentilla recta*	sulfur cinquefoil
	LIVU2	*Linaria vulgaris*	yellow toadflax
	LEVU	*Leucanthemum vulgare*	oxeye daisy
	CIVU	*Cirsium vulgare*	bull thistle
	CEST8	*Centaurea stoebe*	spotted knapweed
	ACRE3	*Acroptilon repens*	Russian knapweed
	CYOF	*Cynoglossum officinale*	hounds-tongue
II	CADR	*Cardaria draba*	whitetop
	ANAR6	*Anthemis arvensis*	corn chamomile
	COAR4	*Convolvulus arvensis*	field bindweed
	CEDI3	*Centaurea diffusa*	diffuse knapweed
	HYNI	*Hyoscyamus niger*	black henbane
	VETH	*Verbascum thapsus*	common mullein
	CAAC	*Carduus acanthoides*	spiny plumeless thistle
	ARMI2	*Arctium minus*	common burdock
	ARAB3	*Artemisia absinthium*	absinthe wormwood
	SATR12	*Salsola tragus*	prickly Russian thistle

Priority Class	Code	Name	Common Name
	CIIN	*Cichorium intybus*	Chicory
	TRPE21	*Tripleurospermum perforatum*	scentless chamomile
III	CESO	*Centaurea solstitialis*	yellow star-thistle
	BRTE	*Bromus tectorum*	Cheatgrass
	ONAC	*Onopordum acanthium*	Scotch thistle
	LIDA	*Linaria dalmatica*	Dalmatian toadflax
	TAVU	*Tanacetum vulgare*	common tansy
	TARA	*Tamarix ramosissima*	salt cedar
	LELA2	*Lepidium latifolium*	perennial pepperweed
	EUESU	*Euphorbia esula var. uralensis*	Russian leafy spurge
	ELAN	*Elaeagnus angustifolia*	Russian-olive
IV	DIFU2	*Dipsacus fullonum*	common teasel
	CACA19	*Carum carvi*	wild caraway
	ANCO2	*Anthemis cotula*	Mayweed chamomile
	SEJA	*Senecio jacobaea*	tansy ragwort

Comprehensive Evaluation Report compiled for the GMUG in 2006 showed an increase in invasive species, with “knapweed and thistle moving upward in elevation along forest roads” (USDA Forest Service, 2006d). The report cited ornamental species on NFS lands, presumably originating from private lands and communities located within forest boundaries, as well as an increase in cheatgrass, which was found to have moved into areas disturbed by fire on the Uncompahgre Plateau (USDA Forest Service 2006d, pp. 42- 43.)

The distribution of mapped invasive plants has been modeled across the GMUG based on the priority of management, the invasibility of the individual species, and the area of occupied infestation. This is displayed in Figure 32. The lower weighted cells (represented by white and greens) have none to few known infestations that are of management priority. The higher weighted cells (represented by red) identify areas where there are heavier infestations of invasive plants of management priority.

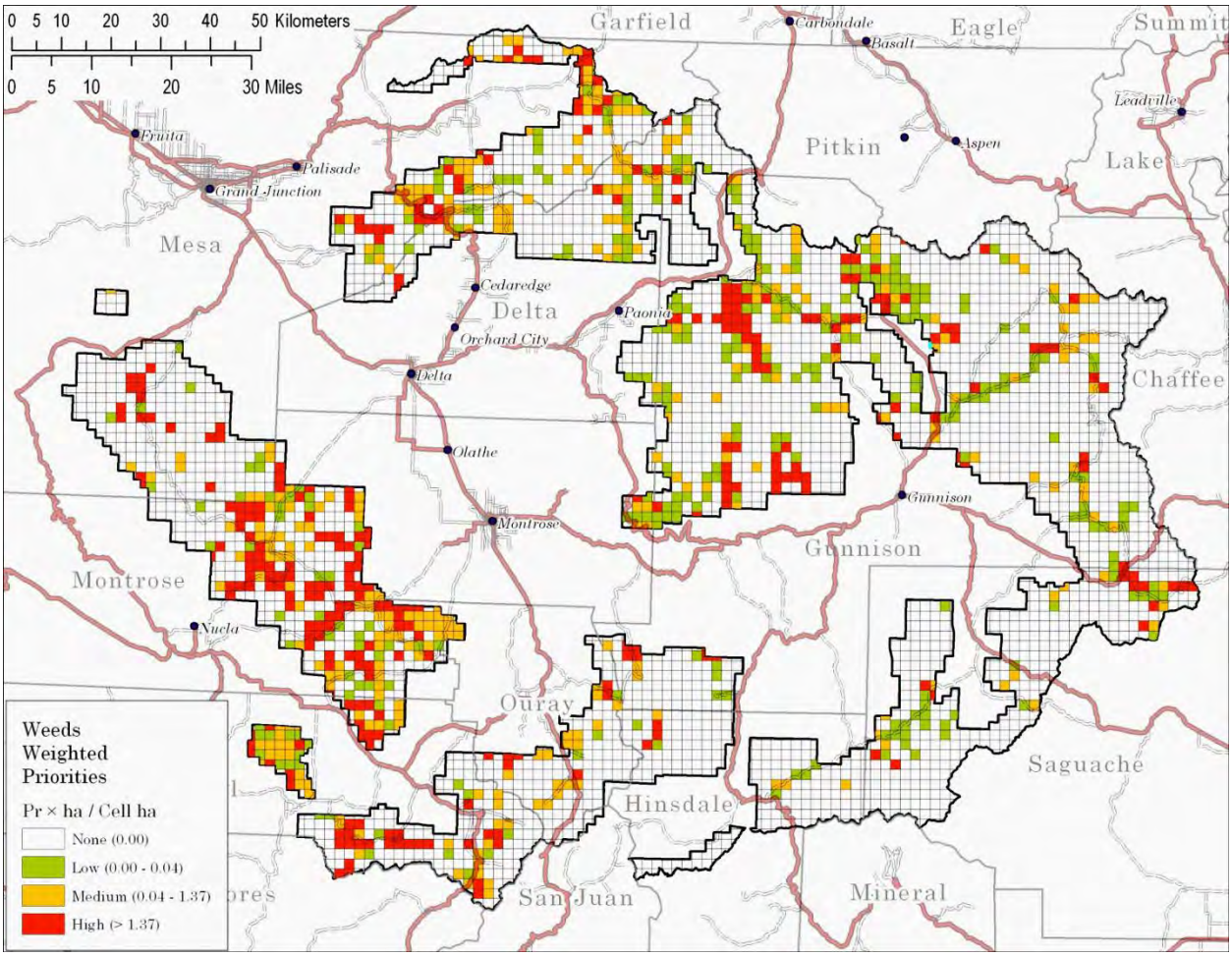


Figure 32. Distribution and concentration of management priority invasive plants on the GMUG, based on the invasive inventory and priorities.

Habitat Vulnerability and Vectors

Habitat vulnerability is controlled by both biotic and abiotic factors of the environment that influence the success of propagules of nonnative species to occupy a site (D'Antonio et al., 2001). Abiotic factors that influence habitat vulnerability include climate (macroclimate and microclimate), water availability and soil nutrients and toxicity. Invasive plants can alter these abiotic processes once established. Some of the known biotic factors that influence habitat vulnerability include the competitive capacity of other species in the plant community, the presence of required mutualists for the invader, herbivore pressures, and in some cases species diversity (D'Antonio et al., 2001).

Characteristics that increase the probability of a community's invasibility include a frequent disturbance regime, (Bossard and others 2000, MacDougall et al, 2005), overstory canopy cover and litter and duff cover (Merriam et al., 2006, Keeley 2006). Biodiversity has sometimes been

linked with resistance of native communities to invasibility (Kennedy and others 2002) with the hypothesis that the more native species inhabit niches (localized environmental conditions), the less opportunity for invasive species to colonize. (Meiners et al., 2004, Robinson et al., 1995, D'Antonio et al., 2001).

The SBEADMR project area is composed of a variety of vegetation types, including coniferous forest, aspen stands, mountain shrublands, mountain grasslands, sagebrush shrubland, riparian areas, roadsides and openings within the forest. The Grand Mesa, Uncompahgre and Gunnison Proposed Land Management Plan (USDA 2006a) assessed the risk of invasibility of vegetation cover types. In general, vulnerability in wildlands is low in desert and semi-desert elevations, (mostly below forest), then increases to high at medium elevations, declining to very low at high elevations (colder with short growing seasons, mainly in wilderness areas). Vegetation along major drainages and more open vegetation types were observed to have higher vulnerability. Spruce-fir, high elevation lodgepole pine and cold, windswept alpine cover types have a very low risk of invasion. Lodgepole pine, spruce-fir and aspen at moderately high elevations have a low risk. Grasslands, lodgepole pine, and spruce-fir at moderate elevations have a moderate risk. Grasslands, sagebrush and willow at lower elevations have a high vulnerability rating. Grass lands and bare ground at lower elevations have a very high vulnerability, though this may be reduced by various abiotic conditions (e. g., precipitation, nutrient availability). The very lowest elevations on the GMUG are usually cold semi-desert sites, with a moderate vulnerability because of the high evaporation and evapotranspiration rates compared with precipitation.

Riparian zones are known to be more vulnerable to infestation by invasive plants than adjacent upland sites (Stohlgren and Chong 2002). Stohlgren and Chong (2002) found that mixed conifer forests with sparse understory vegetation tend to be less invaded than adjacent canopy gaps, aspen stands, and montane meadows. However, they found no difference in vulnerability between grazed and ungrazed sites. Any site is vulnerable to invasion if light, water and nitrogen are made available (Stohlgren and Chong 2002).

Future potential non-project conditions that could increase habitat vulnerability would include:

- Openings or soil fertility changes resulting from severe wildfire
- Openings or loss of cover from insect or disease epidemics in trees and shrubs,
- Disturbed habitat from road maintenance or construction causing loss of soil and native vegetation.
- Climate warming, increasing vulnerability in areas formerly too cold for invasions
- Exposed soil from increased off-road vehicle use
- Exposed soil or reduced cover from over-use by big game animals, especially in their winter ranges
- Increased exposure to invasive plant propagules carried by increased levels of people recreating, pack animal use, and off-road vehicle use.

Parts of the analysis area are remote and rugged topographically. The main vectors for spread in these areas would be recreation, wildlife, wind and water. Though all species have the potential to become established with a single introduction, a few, like cheatgrass, potentially have a higher probability of successful introduction into remote areas. In addition to wildlife, livestock, such as cattle and sheep, carry invasive plant propagules (Ferguson et al., 2003); humans are also a major vector for propagation and spread of invasive plants.

Important pathways applicable in the treatment area include roads, water course ways, private property, water inputs (nearby dam and boat launches), and hiking trails. Roads are thought to promote invasive plant distribution and abundance due to two important mechanisms: the creation of suitable habitat (road maintenance disturbance and reduced competition from native plants) and the increase in vectors (e.g. vehicles, animals) (Ferguson and others 2003). These pathways are often the sites of greatest invasion, as they often combine continuous disturbance and higher frequencies of vectors. Roads are the most important habitat to consider when evaluating invasive plants because they create areas of localized habitat that is maintained at an early successional stage, which results in high vulnerability to invasive species. Similarly, other highly disturbed or early successional habitat such as construction sites, trails, campgrounds or landings have a high vulnerability. The SBEADMR analysis area has an extensive existing road and trail system, which increases its inherent vulnerability.

Among recommended management practices for invasive species management, there are several of great importance (Catford and others 2009):

- Strict quarantine and screening measures
- Increase health of indigenous species
- Control/eradicate non-indigenous facilitators
- Concentrate weed control in dispersal corridors
- Time weed control efforts so it is concentrated post-disturbance
- Concentrate weed control at propagule source
- Minimize disturbance in uninvaded areas

Habitat vulnerability is a combination of many factors. These factors interact with vectors synergistically to create areas with greater vulnerability and risk for invasion. Figure 33 displays the weighted risk.

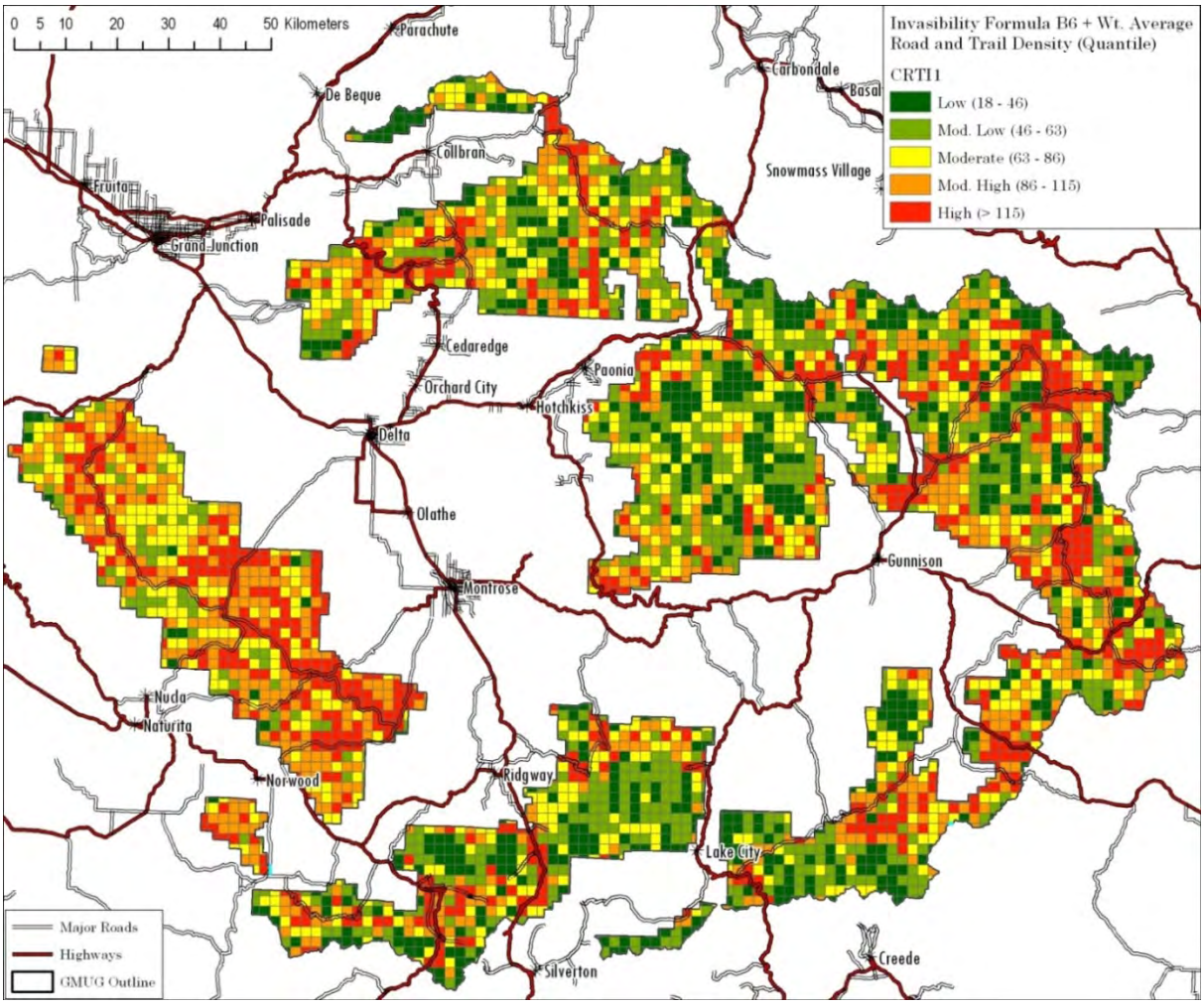


Figure 33. Predicted habitat vulnerability based on aspect, elevation, vegetation, precipitation, slope, and road and trail densities.

Alternative 1 (No Action) – Direct and Indirect Effects

The No Action Alternative is used as a basis for comparing the effects of the Proposed Action and other alternatives. Under the No Action alternative, current management plans would continue to guide management of the project area, and related, ongoing treatments would continue to occur. The environmental effects of treatments not associated with SBEADMR are documented in separate environmental documents. The result of less active vegetation management is difficult to predict, as there are numerous successional pathways of invasive species that depend on many factors, including climate change and wildfire.

The general trend with an absence of disturbance will be that some of the invasive species will become less abundant as native overstory canopy increases, decreasing available light. However, areas lacking overstory, possibly due to beetle kill or aspen decline, would likely have increases

in densities of invasive plant species. Species with low canopy cover requirements and high ecological amplitudes such as cheatgrass have the potential to spread into all habitats with lower cover values, though the right combination of factors would need to exist.

Alternative 1 (No Action) Cumulative Effects

Cumulative effects that result in ongoing ground disturbance and have high vector movement (i.e. recreation, wildfire, roads, trails), are known to introduce and spread invasive species; these activities would continue in the No Action Alternative. Current invasive species management would continue to be implemented.

Effects Common to All Action Alternatives

Treatment Design Features

Risk of invasive plant infestations will be minimized by design features to wash and clean vehicles and remove seed from clothing; despite best intentions to remove all seed and propagules, some probability of seed and propagule spread remains due to ongoing recreation use, animal migrations, the prevalence of invasive species impacts in the proposed treatment areas, and the presence of dispersal vectors.

Individual design features may or may not be effective and reducing the potential for introduction and spread of invasive plants; pre-treatment planning will establish which features are necessary for treatment-specific conditions and activity types.

The following are design features that are included for all action alternatives. The design features are established in response to the effects described in this section, and are intended to focus efforts on planning, prevention, control and monitoring, thereby reducing the effects of increased proliferation of invasive plants associated with treatment actions. The design features do not address activities or factors not associated with treatment activities.

Table 48. Design Features for Invasive Plants.

Design Feature	Trigger for Use	Description	Effect
IW-1	Any ground-disturbing activity	Practices - Before ground-disturbing activities begin, inventory and prioritize weed infestations for treatment in project operating areas and along access routes. Control weeds as necessary. A - Annually, vegetation management personnel should collaborate on project layout and design. During layout of commercial and non-commercial mechanical treatment or prescribed burn units, forest vegetation management personnel should evaluate invasive risks, analyze potential treatment areas for invasive weeds within high risk sites to identify prevention practices and minimize weed establishment and spread.	Minimize or prevent the spread of new or existing weeds
IW-2	Any vegetation treatment	Practices - Identify what weeds are on site, or within reasonably expected potential invasion vicinity, and do a risk assessment accordingly. A - Inventory non-native invasive plant populations within and adjacent to treatment areas and access roads prior to vegetation treatment. Inventories will occur during the proper time of year for detection, and will occur in sufficient timing to conduct necessary pre implementation treatments.	Minimize or prevent the spread of existing weeds
IW-3	New project design	Practices - Design projects to avoid new introductions or spread of existing infestations. A - Any infestations of weeds will be treated prior to implementation as part of the project. B - Consider excluding areas from prescribed burning where there are infestations of fire-proliferating species (example, cheatgrass).	Minimize or prevent the spread of new or existing weeds
IW-4	Movement of contaminated vehicles, equipment, personnel, or materials into a project area	Practices - Prevent the accidental spread of invasive species carried by contaminated vehicles, equipment, personnel, or materials. A - Establish and implement standards and requirements for vehicle and equipment cleaning to prevent the accidental spread of aquatic and terrestrial invasive species on the project area. Use standard timber sale contract provision WO-CT 6.36 to ensure appropriate equipment cleaning. Equipment cleaning should be conducted after working in areas with known infestations, and prior to bringing equipment onto the National Forest. B - Locate and use weed- free project staging areas. Avoid or minimize all types of travel through weed- infested areas, or restrict to those periods when spread of seed or propagules are least likely. C - Workers need to inspect, remove, and properly dispose of weed seed and plant parts found on their clothing and equipment. Proper disposal means bagging the seeds and plant parts and incinerating them. D - All imported materials (erosion control materials, soil, gravel, etc.) should be from a “weed-free” source or area. E - Monitoring will occur where imported materials have been	Minimize or prevent the spread of new or existing weeds

Design Feature	Trigger for Use	Description	Effect
		placed to ensure no new infestations have been established.	
IW-5	Actions that disturb native vegetation and soil	Practices - Retain native vegetation to the extent possible to prevent weed germination and establishment, in and around activity area and keep soil disturbance to a minimum. A - Timber purchasers and contractors will re-seed disturbed areas (as designated by the Forest Service) with an appropriate certified weed-free native seed mix (USDA Forest Service 2008) to avoid introduction of nonnative invasive plants and promote re-vegetation of native species. B - Throughout the implementation period of the proposed action, the Forest Service should maintain flexibility to defer cut units or stands within priority areas from treatment due to the discovery of significant new invasive plant populations with potential to disrupt the functioning of native plant communities. C - Where fuel reduction, timber harvest and other resource objectives necessitate ground disturbance and soil exposure, or substantial ground cover and canopy removal, include appropriate re-vegetation or invasive plant management strategies in the fuel treatment plan. Where necessary, rehabilitate/restore or treat disturbed areas after management activities and conduct follow up monitoring on these areas susceptible to invasive plant spread. D - Rehabilitate/restore or treat disturbed areas after fuel management activities and conduct follow up monitoring on these areas susceptible to invasive plant spread. E - Cover and reduce exposure of bare ground. Use on-site chipping or treated fuels from mastication to cover bare soil to prevent seed establishment where appropriate. See SV-4 concerning areas where mineral soil exposure would be needed to assist with natural regeneration. F- Slash and burn piles will be located away from known invasive plant populations and will be assessed for restoration and revegetation needs.	Retain native vegetation and minimize soil disturbance

Design Feature	Trigger for Use	Description	Effect
IW-6	Actions in areas of existing infestations	Practices - Control and treat existing infestations to prevent project-associated spread and proliferation. A - Coordinate project activities with any nearby herbicide application to maximize cost effectiveness of nonnative invasive plant treatments. B - Treatment of noxious weeds will follow Forest Service policy regarding certification of applicators and reporting of data to Forest Service data bases. C - Treatments of noxious weeds will follow the District Noxious Weed Treatment Decision Notice. D - Populations of noxious weeds should be aggressively treated with the appropriate management tools. This may include treatment with herbicides, grazing, cultural, and biological methods, consistent with the GMUG district decision notices.	Minimize the spread of existing weeds
IW-7	Implementation of a project	Practices - Monitor project area for new infestations and to assess efficacy of treatments. A - Inspect and document all limited term ground-disturbing operations in infested areas for at least three growing seasons following completion of the project. For on- going projects, continue to monitor until reasonable certainty is obtained that no new infestations have occurred. Provide for follow-up treatments based on inspection results. B - Consider modifying design feature implementation for future project implementation based on considerations such as efficacy, cost, and other unforeseen impacts. C - Consider including other design criteria for treatment-specific considerations.	Minimize or prevent the spread of new or existing weeds

These design features as individually listed may or may not be effective in preventing invasive plant introduction and spread, and in many situations will only be effective if combined to meet the treatment-specific situation. This list of design features should be evaluated when implementing each treatment, in order to choose the features most appropriate to the individual site. Prevention is the first objective and the most effective strategy with invasive plant management (USDA Forest Service 2001).

Direct and Indirect Impacts

Direct impacts associated with the action alternatives increasing risk of the spread of all invasive plants include movement of propagules on machinery, vehicles, clothing, and equipment between and within treatment units. Washing equipment will reduce the risk of spread on mechanized equipment between treatment sites. Between washings, there is a high risk that propagules will be spread within the areas treated. Direct impacts also include short term decreases in invasive cover as all treatment methods will remove or reduce above ground

portions of the plant. In the long term there will be no net decrease as all of the invasive plants will regenerate from underground vegetative parts (perennials) or establish from seed. There is the potential that prescribed fire treatments will kill the seeds of some portion of the seed bank of weeds or standing seed heads, which will be a beneficial short term impact, but if the weed seed bank is partially killed, then so will the seeds of natives on which the revegetation may depend.

There are six main factors to consider when considering the indirect impact of the action alternatives in facilitating increases of nonnative invasive species:

1. Any disturbance decreases the environmental resistance to invasive nonnative plant species, especially disturbance that increases bare soil.
2. Long distance dispersal species have the capacity to quickly move into treatment areas near infestations (e. g., knapweeds, bull thistle, yellow star-thistle, see Appendix A in the Invasive Plants report located in the project record).
3. Changes in vegetation structure, canopy closure, and soil cover are important factors affecting habitat that create suitable habitat for invasive plants.
4. Seed banks for nonnative invasive plants could be present before treatment, and be germinated by treatment implementation.
5. All ground disturbing activity within invasive species occurrences will result in increases in abundance and distribution of invasive species in the absence of additional management, such as weed eradication and control treatments immediately post-disturbance, and implementation of other appropriate design features.
6. Increases in abundance and distribution of invasives are variable based on variable biotic and abiotic factors such as weather patterns, soil types, wind patterns (airborne seeds), etc.

All invasive species are able to migrate into new areas, so when suitable habitat is created close to existing occurrences there is a high risk for population expansion. The treatment dependent factors that influence invasive plants' potential mobility to new sites depend on the six factors listed above, especially when referring to the creation of suitable habitat. Mobility also depends on non-treatment dependent factors such as an existing seed bank.

The action alternatives will result in alterations to vegetation structure and species composition. Structural changes to vegetation are the direct impact of the action alternatives and include changes to understory and overstory vertical and horizontal spatial composition through vegetation removal to meet the project's forest health and diversity objectives. Compositional changes in species are an indirect effect of the action alternatives caused by the present species assemblage and the successional pathway that results from the particular treatment applied.

All actions associated with treatment implementation have the potential to increase invasive nonnative plant species abundance and distribution. Creation of suitable habitat for nonnative invasive plant species is the primary adverse indirect impact to vegetation associated with the action alternatives. The factor that has been the most strongly correlated with invasive plant species richness and abundance in sites where vegetation management has occurred is removal of overstory canopy, litter and duff cover (Merriam et al., 2006). Reducing overstory canopy cover allows light to penetrate to the soil layer; combined with reduced water and nutrient competition, this can allow for invasive nonnatives to increase in extent and abundance. Disturbance, litter and duff removal reduce a plant community's resistance to invasion (D'Antonio et al., 2001).

Overstory canopy reduction is associated with the proposed treatments, which include timber harvest, mastication, prescribed fire and hand thinning, and combinations of these treatments. There is an inversely proportional relationship between overstory canopy cover and invasive species cover, meaning that as overstory canopy decreases, invasive plant cover increases (Coulter et al., 2010, Keeley and McGinnis 2007, Merriam et al., 2006, Gibson 2002). The magnitude of the impacts from the resulting condition depends on the amount of overstory canopy reduction. The effect of overstory canopy reduction, combined with prescribed fire, would not be a uniform reduction across the landscape, but would occur as a mosaic with localized areas of overstory canopy loss, and areas with no net change. More uniform patterns of overstory canopy removal could result from spruce salvage treatments, aspen coppice treatments and road construction. Any of these treatments (with or without prescribed fire) could result in further decreases or greater variability in canopy cover.

The action alternatives may result in alterations to current successional pathways. A successional pathway is the sequence of communities that has occurred (or could occur) on a site over time. There are several factors associated with the action alternatives that impact successional pathways and changes in vegetation composition. These factors include types of disturbance, frequency of disturbance, and the vegetation response to the types and frequencies of disturbance. For the project area, fire was likely the dominant historic disturbance regime that was the primary force in shaping successional pathways. The introduction of invasive plants can result in altered successional pathways as they are very efficient at exploiting initial, early successional resources (e.g. lighter nutrients).

A review of the literature found that the majority of vegetation treatments proposed for the action alternatives would result in increases of non-native species ranging from slight increases to substantial increases (Thysall and Carey 2001, McGlone et al., 2009). The range of results is likely a function of the presence of invasive species prior to treatments. Response of invasives post-fire is most pronounced when invasives were present before fire treatments were initiated.

(Zouhar et al., 2008). There is also variability in the measured differences in increase between treatment types.

The following is a brief discussion of activities associated with treatment implementation and the factors associated with each of their impacts to the environment.

Roads

In wildlands, roads often have the highest concentrations of invasive plants. Road construction and maintenance create prime habitat for invasion as most invasive species are early successional that prefer highly disturbed sites (Ferguson and others 2003). Roads create the combination of factors associated with invasive plant establishment (creation of suitable habitat and vectors that transport and introduce seed or propagules) (Ferguson et al., 2003). Roads have also been found to have a greater impact on the distribution and abundance of invasive plants than the associated vegetation management treatments (Birdsall et al., 2012). There is high risk of invasion associated with all road activities, though implementation of design features would reduce the amount of disturbance, thereby reducing the likelihood of spreading existing invasive populations.

Timber Harvest

A review of studies conducted in 2010 looking at the response of the understory to timber harvest treatments found there was an increase in the frequency, richness and cover of invasive plants after harvest. This study found that these factors were increased with increasing entries and combinations of treatment types (Sutherland and Nelson 2010). This means that if a timber harvest was followed with prescribed fire, there was a corresponding increase in invasive plants. This review also found that these factors are compounded by propagule pressure (Jeschke 2014), though introductions did account for increases in many of the studies. Where silvicultural prescriptions require bare soil (20-40%) for natural regeneration (design feature SV-4 in Appendix B) the risk for invasive species to establish will increase.

Table 49. Location, Forest Type, Treatment Types, Response Variables, Direction of Response, and Authorship of Investigations of the Effects Of Multiple Silvicultural Treatments on Nonnative Plants. (Reproduced from Sutherland and Nelson 2010.)

Location	Forest type	Metric	Harvest effect	Intensity effect	Harvest + burn versus harvest	Nonnative species	Change cover or frequency	Noxious species	Author
Arizona	PP	Frequency	Increase	Increase		3	1–14	3	Abella and Covington 2004
Oregon	S/WH	Frequency	Decrease			1			Alaback and Herman 1988
Minnesota	A	Richness	Increase			1		1	Alban et al. 1994
Washington	DF	Richness	Increase	Increase		3–20			Aukema and Carey 2008
Oregon	DF/WH	Cover	Increase				<1		Bailey et al. 1998
		Frequency	Increase				<1		
		Richness	Increase			4–10		5	
California	Mixed conifer	Cover	Increase	Increase		1–7	3	1	Battles et al. 2001
		Richness	Increase	Increase					
Virginia	Hardwood	Density	Increase			1	0.3		Carter and Fredericksen 2007
California	Mixed conifer	Cover	Increase		Increase	2	1	2	Collins et al. 2007
		Richness	Increase		Increase		<1		
Washington	WH/DF, S/WH	Cover	Increase				<1–18		DeFerrari and Naiman 1994
		Density	Increase				<1–4		
		Richness	Increase			1–27		13	
Montana	PP	Cover	Increase	Increase	Increase		<1–2		Dodson and Fiedler 2006
		Richness	Increase		Increase	1–10		8	
Washington	PP/DF	Cover	Increase		Increase		<1		Dodson et al. 2008
		Richness	Increase		Increase	0–7		1	
Oregon	DF	Cover	Increase		Increase	0–6	0–8	1	Dyrness 1973
		Frequency	Increase		Increase				
		Richness	Increase		Increase				
West	Conifers	Cover	Increase				0–7		Freeman et al. 2007
		Richness	Increase			0–4			
Arizona	PP	Cover			Increase				Fulé et al. 2005
		Richness			Increase			2	
Oregon	Various	Cover	Increase	Increase			<1–5		Gray 2005
		Frequency	Increase	Increase		8	<1–14	2	
Arizona	PP	Forb cover	Decrease		Increase		<6		Griffis et al. 2001
		Forb richness	Increase		Increase	2	<3	1	
		Gram cover	Increase		Increase		<5		
		Gram rich	Increase		Increase	2	<2	1	
Oregon, Washington	DF	Cover	Increase				11–17		Halpern and Spies 1995
		Richness	Increase			1	<10		
Arizona	PP	Seeds	Increase					1	Korb et al. 2005
British Columbia	LP	Richness	Increase	Increase		3			Lindgren et al. 2006
Montana	PP/DF	Cover	Increase		Increase		<3		Metlen and Fiedler 2006
		Richness	Increase		Increase		1–10	2	
Oregon	J	Biomass	Increase					1	Miller et al. 2005
Arizona	PP	Biomass	Increase		Increase	1		1	Moore et al. 2006
Arizona	PP	Abundance	Increase		Increase		<3	2	Neary et al. 2002
Washington	DF	Cover	Increase				<1		Nelson and Halpern 2005
		Frequency	Increase			5	2–31	2	
Washington	PP	Cover	Increase	Increase	Increase		<1		Nelson et al. 2008
		Richness	Increase	Increase	Increase	42	2–6	11	
Oregon, Washington	WH	Frequency	Increase			8	1–88	3	North et al. 1996
British Columbia	DF	Cover	Increase					1	Page et al. 2005
Oregon	Chaparral, oak	An grasses cover	Increase						Perchemlides et al. 2008
		An forb cover	Decrease						
Michigan, Wisconsin	Northern hardwood	Cover	Increase	Increase		1	0–5		Scheller and Mladenoff 2002
		Frequency	Increase	Increase			2–34		
Washington	Mixed conifer	Cover	Increase		Increase	13	<6	4	Scherer et al. 2000
Oregon	WH/DF	Cover	Increase			5	0–3	3	Schoonmaker and McKee 1988
Wyoming	LP, SF	Presence	Increase			7	<1	2	Selmants and Knight 2003
Massachusetts	Mesic forest	Frequency	Increase						Silveri et al. 2001
Idaho, Montana	Various conifers		Increase					2	Stickney and Campbell 2000
Washington	DF	Cover	Increase	Increase		3	<1%		Thomas et al. 199
		Frequency	Increase						
South Dakota	PP	Biomass	No exotics						Thompson and Gartner 1971
Washington	DF	Cover	Increase				<1		Thysell and Carey 2000
		Richness	Increase					3	
South Dakota	PP	Biomass	Increase	Increase					Uresk and Severson 1998
		Richness	Increase					3	
Oregon	J	Biomass	Increase					1	Vaitkus and Eddleman 1987
California	Mixed conifer	Frequency	No exotics						Wayman and North 2007
South Dakota	PP	Biomass	Increase	Increase	Increase			1	Wienk et al. 2004
Oregon	PP/DF	Cover	Increase		Increase		<3	1	Youngblood et al. 2006
		Frequency	Increase		Increase				
		Richness	Increase		Same				

A = aspen, *Populus tremuloides*; DF = Douglas-fir, *Pseudotsuga menziesii*; J = western juniper, *Juniperus occidentalis*; LP = lodgepole pine, *Pinus contorta*; PP = ponderosa pine, *Pinus ponderosa*; S = spruce, *Picea* spp.; SF = spruce-fir, *Picea* sp. and *Abies* sp.; WH = western hemlock, *Tsuga heterophylla*.

Mastication (including chipping treatments)

Vegetation debris is spread out by machinery during mastication. Some mastication methods leave areas of bare soil that have a moderate to high potential of being colonized by nonnative invasive plants, and some areas where the residual material suppresses nonnative establishment (Wolk and Roca 2008). Other mastication methods distribute woody debris more evenly across all areas, reducing erosion and the risk of invasion. Recent studies (Potts and Stephen 2009) have concluded that mastication may provide fuels management with an effective means of reducing fuel loading over a longer period of time but with an increase in nonnative invasive plants. Areas where mastication was applied showed much higher plant richness and abundance for both native and nonnative species in comparison to prescribed fire, including the highest proportion of nonnative plants (Potts and Stephens 2009). Other studies (Knapp et al., 2007) in conifer dominated vegetation types found mastication had significantly higher nonnative response compared to prescribed fire, though when mastication was *combined* with prescribed fire, there was the highest nonnative invasive response (Kane et al., 2010, Coulter et al., 2010).

Piling and Pile Burning

Studies have found that the footprints where slash pile burning has occurred have the greatest distribution and abundance of invasive plants (Keeley 2006, Jimenez Esquilin et al., 2006), inherently giving these areas a high risk for invasion. Depending on the size of the pile and its residence time, the soils below may become sterile, reducing native seed banks. This could reduce competition for invasive nonnative plant species. Another potential factor increasing risk with this action is the release of nutrients through the burning of organic materials, which could encourage invasive nonnative species growth, though conversely, this same release could provide nutrient resources for native species. These impacts are likely to be greatly reduced when pile construction is conducted by hand (and thus more dispersed and less concentrated), when compared to machine piling.

Broadcast Burning

In forested stands, fire severity has been found to be directly proportional to the abundance and species richness of invasive nonnative plant species (Griffis et al., 2001, Erickson and White 2007) meaning that the higher the fire severity, the higher the invasive plant response. In situations where more detailed history is available, it is apparent that sites experiencing increases in invasives are closely tied to pre-fire infestations, presence of corridors, and weeds introduced during the fire. Areas with no pre-fire weeds and without human or vehicle vectors are usually weed-free after the fire (Johnston 2012). Studies (Bradley et al., 2006, Collins et al., 2006) have found broadcast burning to have the lowest nonnative plant response when compared to mastication and hand treatment areas in vegetation types with high shrub components. Broadcast burning can result in amplified invasive plant response when combined with other treatment

types (Table 49, Sutherland and Nelson 2010), especially with low intensity fires (Harrod and Reichard 2002).

Fire Lines and Staging Areas

Constructed fire lines and use of staging areas can act as pathways for invasion of roadside invasive nonnative plants into other areas and adjacent wild lands. Fire line construction will establish dispersal vectors and foot travel on constructed fire lines will result in naturalized nonnative invasive plant species seed and propagule dispersal in treatment units. Where invasive species are present prior to fire line construction, spread to nearby and adjacent uninfested areas are likely, though treatment design features including pretreatment of invasive plants will reduce this risk. Native vegetation recovery on fire lines will be slower than in adjacent treated areas because fire lines are cleared of organic matter that greatly aids native plant establishment in the short-term, and construction of fire lines typically results in soil compaction that restricts rapid root expansion and plant available water. Rehabilitation of fire lines immediately following the application of prescribed fire would minimize the increase of invasive species distribution and abundance in proposed treatment units; however the threat of greater distribution and abundance remains likely due to the highly disturbed conditions and slow native recovery of fire lines.

Summary of Impacts to Abundance and Distribution of Invasive Plant Species

All activities have the potential to increase invasive plants, but there is a range in the potential magnitude of invasive plants response. The treatment-dependent factors that will affect the risk of response will be the level of soil disturbance, the degree of change in canopy coverage, introduction of new infestations, where the activities occur, and which activities are involved. The greatest invasive plant response will likely be where road activities and mechanically-constructed pile burning activities occur, especially if there is an existing infestation nearby. The greatest potential vector for introduction of new infestations would be associated with vehicles utilized for treatment activities.

The non-treatment dependent factors that will influence invasive plant abundance and distribution will include; the location of the proposed treatment site, the site characteristics that result in high to low risk for infestation, whether infestations are known to occur at and nearby the site, and the current risk of spread and introduction by existing non-treatment dependent vectors.

Integration of the design features that inventory and treat occurrences before activities commence, maintain soil and canopy coverage, prevent the accidental introduction and spread of infestations, restore or rehabilitate highly disturbed areas, and monitor and treat new infestations will greatly reduce the risk of invasive species establishing and persisting with treatment

activities. However, with the level of treatment proposed and probable resulting ground disturbance, invasive plants are likely to appear in new areas.

Alternative 2 (Proposed Action) – Direct and Indirect Effects

Alternative 2, the Proposed Action, addresses the effects of the spruce beetle epidemic and sudden aspen decline by implementing vegetation management activities on a landscape scale. As with Alternatives 3 and 4, the target number of acres analyzed for treatment is 70,000-120,000 across the life of this project; these acres include WUI. Approximately 4,000-6,000 acres of commercial harvest are anticipated annually, and approximately 3,000-6,000 acres of non-commercial mechanical or prescribed burning treatments are anticipated annually.

The effects from Alternative 2 are within the range of alternatives described in the direct, indirect, and cumulative effects under Effects Common to all Action Alternatives listed above. Overlaying the opportunity areas with the habitat vulnerability modeling, Alternative 2 has almost 70% of the opportunity areas in moderately-high-risk or high-risk for invasive plants (Table 50). Active treatments in these areas pose a high risk for the spread of invasive plants, but this risk is minimized by the implementation of the design features associated with all action alternatives.

Table 50. Percent of Opportunity Areas for Alternative 2 Invasibility Risk Classes.

Invasibility Risk	Grand Valley	Gunnison	Norwood	Ouray	Paeonia	Project wide
Low	4%	3%	5%	1%	2%	3%
Mod. Low	8%	9%	12%	1%	17%	8%
Moderate	20%	17%	26%	16%	16%	19%
Mod. High	38%	30%	24%	27%	32%	30%
High	31%	42%	33%	55%	33%	40%

Alternative 3 (Public Safety) – Direct and Indirect Effects

Alternative 3 shifts the geographic extent of treatments such that treatments would be limited to the targeted vegetation types within the wildland-urban interface (WUI) and to road corridors and additional identified infrastructure extending beyond the WUI, with all other aspects of treatments remaining the same. This alternative has the potential for the greatest concentration of effects as it has the highest potential for treatment per area ratio. This alternative calls for higher spatial concentrations of treatments than the other alternatives; these include temporary roads, road reconstruction activities, mechanical treatments, and other ground disturbing activities. The effects from this alternative are within the range of alternatives described in the direct, indirect,

and cumulative effects under Effects Common to all Action Alternatives described above. Overlaying the opportunity areas with the habitat vulnerability modeling, almost 74% of the opportunity areas in Alternative 3 are in moderately-high-risk or high-risk for invasive plants (Table 51). Active treatments in these areas pose a high risk for the spread of invasive plants, but this risk is minimized by the implementation of the design features associated with all action alternatives.

Table 51. Percent of Opportunity Areas for Alternative 3 in Invasibility Risk Classes.

Invasibility Risk	Grand Valley	Gunnison	Norwood	Ouray	Paeonia	Project wide
Low	3%	2%	4%	2%	2%	3%
Mod. Low	7%	5%	13%	1%	17%	8%
Moderate	19%	17%	16%	9%	16%	15%
Mod. High	33%	25%	26%	18%	28%	26%
High	37%	51%	41%	70%	37%	48%

Alternative 4 (Spruce Salvage) – Direct and Indirect Effects

Alternative 4 proposes up to120,000 acres of aspen and spruce fir (salvage only) treatments over 718,000 acres. Alternative 4 limits spruce treatments to salvage only; aspen treatments would be the same as in Alternative 2. Spruce-fir treatments would primarily be conducted where mechanical treatments could occur (on slopes <40%). The effects from this alternative are within the range of alternatives described in the direct, indirect, and cumulative effects under Effects Common to all Action Alternatives. Overlaying the opportunity areas with the habitat vulnerability modeling, Alternative 4 has almost 70% of the opportunity areas in moderately-high-risk or high-risk for invasive plants (Table 52). Active treatments in these areas pose a high risk for the spread of invasive plants, but this risk is minimized by the implementation of the design features associated with all action alternatives.

Table 52. Percent of Opportunity Areas for Alternative 4 in Invasibility Risk Classes.

Invasibility Risk	Grand Valley	Gunnison	Norwood	Ouray	Paonia	Project wide
Low	4%	3%	5%	1%	2%	3%
Mod. Low	8%	9%	12%	1%	17%	9%
Moderate	20%	17%	26%	16%	15%	19%
Mod. High	38%	28%	24%	27%	31%	29%
High	31%	43%	33%	55%	34%	40%

Comparison of Action Alternatives

The key difference between the action alternatives are the "opportunity areas" where the treatments could occur. As stated previously, there is overlap in the opportunity areas that are common to all alternatives where treatments could occur regardless of selected alternative. Between action alternatives, the opportunity areas increase in area from Alternative 3 to Alternative 2, with the greatest area in Alternative 4. The key distinguishing factor is where the treatments occur and whether they are near invasive plant occurrences and what activity type is utilized for implementation. This means that there is the potential for no difference in impacts and effects between alternatives, or a more substantial difference, if the activities implemented and the sites they were implemented in vary greatly between alternatives. The following table (Table 53) attempts to capture the potential for differences:

Table 53. Comparison of Action Alternatives

Comparative descriptor	**Alternative 2**	**Alternative 3**	**Alternative 4**
General description	Proposes 120,000 acres of aspen and spruce resiliency and recovery treatments over 718,000 acres.	Proposes 120,000 acres of aspen and spruce treatments in WUI over 426,000 acres.	Proposes 120,000 acres of aspen and spruce (salvage only) treatments over 718,000 acres. Spruce treatments would only occur where mechanical treatments could occur (slopes <40%).
Sizes of opportunity areas	718,000 acres. Moderate soil impacts possible, spread over large area.	296,392 acres. Treatments in more concentrated area (WUI[1]) compared with other action alternatives potentially resulting in greater hydrologic and soil impacts in a smaller, more highly infested area.	718,000 acres. Associated with more salvage treatments relative to Alternatives 2 and 3, there is a potential for greatest dispersal of soil impacts.
Environmental Baseline	Second largest footprint for opportunity areas. With the exception of invasive plant introduction, could have fewer impacts due to dispersed application of treatments.	Footprint of opportunity area would occur in areas that have generally experienced the greatest ongoing habitat alterations (development), has the highest concentrations of high vulnerability areas, and would have the smallest change from environmental baseline to post implementation environment.	Largest footprint for commercial opportunity area. Potential for the greatest dispersal of activities and impacts. Also has the highest potential for introduction of invasive plants into areas currently uninfested.
Roads	Maximum potential for roads: designed road construction, 60 miles, Temporary road construction, 260 miles, Road reconstruction, 260 miles, Road maintenance, 440 miles. High dispersal of road impacts due to larger affected landscape.	Maximum potential for roads: 70 miles temporary roads, 10 miles designed roads, 260 miles reconstructed roads, 640 miles road maintenance Highest concentration potential for road activities.	Same as 2.
Introduction and	Moderate use of mechanical	Area of treatment with highest	Proposes greatest area available

Comparative descriptor	Alternative 2	Alternative 3	Alternative 4
Spread of invasive plants	treatment, moderate risk for introduction or spread of invasive plants. Potential for introduction and spread of invasive plants due to increased vectors over second largest opportunity area. Risk minimized through use of design features.	concentrations of invasive plants, local introductions the greatest risk. Higher risk of introduction with higher level of road maintenance. Treatments would occur primarily in areas that already have the highest infestations, making it more likely invasive plants would be spread. Risk minimized through use of design features.	for commercial treatment, much of it remote and without invasive plants. Highest risk for introduction. Greater use of mechanical treatment likely with this alternative, greater risk for introduction. Risk minimized through use of design features.
Low Habitat Vulnerability	3%	3%	3%
Mod. Low Habitat Vulnerability	8%	8%	8%
Moderate Habitat Vulnerability	19%	15%	19%
Mod. High Habitat Vulnerability	30%	26%	30%
High Habitat Vulnerability	40%	48%	40%

The findings of this analysis show that there is an increased risk in the rate of spread of priority invasive species and the creation of suitable habitat with implementation of all action alternatives. This risk will be largely mitigated through implementation of design features. Invasive nonnative plant species known from the proposed project area are recognized to have adverse ecological impacts such as changes in the soil chemistry (changes in nitrogen cycling, allelopathy), changes in the soil biota, changes in soil moisture; changes in site and food quality and quantity for other trophic levels; increased competition for resources such as light and nutrients; and changes in ecosystem processes, such as hydrologic regimes or fire regimes.

Cumulative Effects Common to all Action Alternatives

Characteristics that increase the probability of a plant community's invasibility has been hypothesized extensively (Bossard and others 2000, MacDougall and others 2005, Catford and others 2009), but consistently include a frequent disturbance regime of either natural or anthropogenic origin. Areas that have multiple or prolonged disturbances have higher susceptibility to invasion. This implies that where there are overlapping treatments there is the potential for greater adverse and longer term impacts where invasive nonnative species are present.

The following table displays the foreseeable future actions that are likely to contribute cumulatively to the spread and introduction of invasive plants and whether the impacts are anticipated to be similar to those described above in the effects analysis.

Table 54. Present and Future Projects and Activities in the Cumulative Impacts Analysis Area

Agency	District	Foreseeable Future Project	Impacts within the range of those described in direct and indirect impact (Yes/No) and effects analysis and additional comments.
USDA Forest Service	Forestwide	Ongoing Grazing Activities	No
	Gunnison	Cochetopa Hills	Yes, Design Features included to mitigate invasive plants impacts.
	Grand Valley	Mesa Point Fuels treatments	Yes
	Norwood	Naturita Fuels	Yes. Includes invasive plant treatments in project design.
	Grand Valley	Resort Mesa treatments	Yes
	Ouray	Escalante Forest Restoration treatments	Yes
	Gunnison	La Garita salvage treatments	Yes
	Ouray	Owl Creek Road Maintance	Yes.
	Grand Valley	Trickle Park Road improvements and maintenance	Yes.
	Forest-wide, multiple locations	Trail Management	Yes, similar to impacts from roads though greatly reduced.
	Forest-wide	Wild herbivore (elk, deer, moose) browsing and grazing	No
	Forest-wide	Increased recreation pressure, motorized (four-wheel, ATV-UTV)	Yes. Described in affected environment.
	Forest-wide	Increased recreation pressure, mechanized (bicycles)	Yes. Described in affected environment.
USDI BLM	Gunnison Field Office	Gunnison Spruce Beetle Response	Yes
Colorado Parks and Wildlife	Forest-wide	Increased recreation pressure, non-motorized (pack and foot trails)	Yes. Described in affected environment.
Public	Forest-wide	Increased development, creating new WUI	No.
Power and Fuels Companies	Forest-wide, especially Grand Mesa	Construction and maintenance of power line and pipeline corridors	No.
	Several sites across forest	Increased demand for mine and drill facilities	No.
Public	Forest-wide	Deteriorating air quality due to increased population; increases in nitrogen deposition..	No.
Water Provider Agencies	Forest-wide	Water facilities (ditches, reservoirs) construction and maintenance	Yes. Described in affected environment.
Ski Area Companies	Forest-wide	Construction and maintenance of ski facilities, including weed control	No.

The following is a brief summary of the potential range of impacts anticipated from the activities mentioned in the above table. These descriptions summarize the general potential indirect impacts through the pathway of changes to environmental conditions (e.g. increases in invasive species in the cumulative impacts analysis area, climate change, etc.).

Vegetation Management and Fuels Reduction Projects

Currently, there are four Forest Service vegetation management projects that will occur in the cumulative impacts analysis area. The vegetation and fuels reduction projects involve vegetation treatment similar to those proposed in the action alternatives for this project, and thus direct and indirect impacts on site are similar to those assessed in this report. Conducting many projects across the landscape in close temporal and geographic proximity is likely to result in greater cumulative impacts.

Grazing

Livestock grazing management can be beneficial in invasive plant management through the cooperation of grazing permittees and cooperating agencies; but livestock grazing but can also assist in the spread and proliferation of invasive plants. Grazing occurs both on the GMUG and in areas adjacent to the forest. In areas where the action alternatives create soil disturbance where cattle or other grazing animals are used, introductions of invasive plants could occur if propagules are brought in on the animals. Grazers can also create disturbed soils that could result in areas where introductions caused by vectors associated with project activities could occur. Wild animals such as elk, mule deer, and moose can also be vectors for introduction and spread of invasive plants.

Invasive Plant Management

There are ongoing invasive plant treatments throughout the GMUG (please see Appendix A of the Invasive Plants Specialist Report for list of acres treated). These treatments help to reduce the source of propagules that could move into areas where treatment activities occur and reduce the impacts of invasive plants on a landscape scale.

Road Maintenance

There is ongoing road maintenance in and near the analysis area. These projects may result in some increase in localized invasive abundance. This will contribute to adverse impacts as nonnative invasive plants may become established and could invade the project area.

Recreational Use

The analysis area currently has high levels of recreation, and recreation is expected to increase – motorized, mechanized, and non-motorized. Areas with high concentrations of recreation usage are vulnerable to high disturbance levels, and many of these areas are in or near spruce-fir or

aspen forests. These are also sites where introductions of invasive species could occur, due to increased vehicular and foot traffic carrying seeds or vegetative propagules. The overall trend in these areas would create a higher risk for the introduction and spread of invasive plants.

Construction and Maintenance of Power Line and Pipeline Corridors

There are a number of overhead power lines crossing the forest, often through spruce-fir or aspen stands. Forest management is already actively involved in detecting and treating invasive plants in these corridors; it is expected that these efforts will intensify.

There are several pipelines that cross the forest, and maintenance of these (including weed control) is usually done cooperatively between the Forest Service and the companies owning the pipelines. There may be more pipeline applications in future; maintenance is likely to intensify. Many of these are below the spruce and aspen zones, but there are several that cross through spruce-fir or aspen stands. The overall trend for these areas would be increased risk for introduction and spread of invasive plants.

Increased Demand for Mine and Drill Facilities

Demand for mine and drill facilities continue to increase, although only a few of these are near spruce-fir or aspen stands. These are usually areas where intense soil disturbance occurs for a few years, followed by long-term recovery and rehabilitation. Increasing demand is expected, especially on the Paonia District and the eastern part of the Grand Valley District. There will likely be increased focus put on better rehabilitation of mine sites and drill pads, especially for invasives. The overall trend for these areas would be increased risk for introduction and spread of invasive plants.

Increased Development, Creating New WUI

Every year there is more development near or adjacent to the Forest Boundary, creating more wildland-urban interface (WUI). This will increase the area to be disturbed under all action alternatives. Increased WUI will result in greater potential for introduction of invasives onto the forest due to increases in disturbance, increased vector activity, and potentially the escape of planted ornamentals (eg. ivy) into the forest wildlands. The overall trend for these areas would be increased risk for introduction and spread of invasive plants.

Water Facilities (Ditches, Reservoirs) Construction and Maintenance

As demand for water continues to increase (for both agricultural and domestic uses), demand for new water management facilities, and more active management of existing ones, on the national forests will also increase. This will likely result in more disturbances around existing reservoirs and ditches, many of which are in spruce-fir or aspen stands. This concern is Forest-wide,

though there is a great concentration of such facilities on the Grand Mesa. The overall trend for these areas would be increased risk for introduction and spread of invasive plants.

Construction and Maintenance of Ski Facilities, Including Weed Control

Most of the ski areas on the forests have expansion plans, big or small. There will also be ongoing maintenance of existing ski facilities, including new construction within existing permit boundaries, and weed treatments. Most of these ski areas are in the spruce-fir zone. The overall trend for these areas would be increased risk for introduction and spread of invasive plants.

Deteriorating Air Quality Due to Increased Population

For the last few decades, there has been a trend towards greater population numbers in and near these forests, especially around spruce-fir and aspen stands. This trend will likely continue and perhaps accelerate, resulting in more fossil fuel use and more wood-burning, which will deteriorate the air quality on and around the forests. This would result in increased nitrogen deposition which has been found to increase the success of invasive plants (Dukes and others, 2011).

Range

Affected Environment

SBEADMR is proposing vegetation treatments across the Grand Mesa, Uncompahgre, and Gunnison National Forests' five Ranger Districts. Opportunity areas for treatments occur across 193 grazing allotments; 165 are active, 14 are closed and 14 are vacant. An active allotment is one in which a grazing permit has been issued and regular use occurs. Closed allotments have no grazing permit associated with them; they are closed to grazing unless and until NEPA analysis and decision deems otherwise. Vacant allotments have no grazing permit associated with them; however, they may be used by existing grazing permit holders in specific circumstances for example, when needed during or following fire on an active allotment. A full list of allotments that overlap the opportunity areas for each of the action alternatives is available in the project record.

NEPA analysis for the active grazing allotments has been completed and these are currently being managed through a combination of Allotment Management Plans (AMPs) and Annual Operating Instructions (AOIs) as well as through grazing permit administration. Acres currently classified as unsuitable or incapable for grazing are not being proposed for conversion to suitable or capable.

Alternative 1 (No Action) –Direct, Indirect and Cumulative Effects

Activities that result in ongoing ground disturbance and have high vector movement (i.e. recreation, wildfire, roads, trails), are known to introduce and spread invasive species, which can impact the quality and quantity of forage. These activities would continue under the No Action Alternative. Current invasive species management would continue to be implemented.

Direct and Indirect Effects Common to All Action Alternatives

As specified in the Pre-Treatment Checklist (Appendix C), and in compliance with the GMUG LRMP, all range improvements including fences, cattle guards, corrals, water developments, pipelines, troughs, stock trails and stock driveways would be identified in the timber sale, service contract, or burn plan as protected improvements. Range transects and witness trees/posts would likewise be identified and protected. As such, impacts to existing range improvements and management features should be avoided.

Timber and fire staff will work closely with range management personnel to avoid direct conflict from overlapping activities (Table 55; Design Feature RG-1). In order to improve the ecological benefit of a treatment, there may be short-term changes in grazing rotations in advance of treatments or after treatments (Design Feature RG-2). For example, a pasture may need to be deferred or rested from livestock grazing prior to a prescribed burn to ensure there is fuel to carry a fire. Likewise, a pasture may need to be deferred or rested following a vegetation treatment to ensure adequate recovery before livestock grazing returns. There would be no standard timeframe for any such deferment or rest. The District Range Staff would determine whether or not deferment or rest is needed, when deferment or rest is needed (prior to or following treatment), and for how long; they would coordinate with the affected permittee accordingly.

Vegetation treatments proposed in this EIS would generally open up the canopy and encourage growth of the understory, which could increase the forage resources available. Soil compaction from heavy equipment may have localized impacts to forage productivity. Prescribed burns may result in areas of soil impact that could impact forage productivity in localized areas, though design features will be implemented to minimize such impacts; see Soil section and *Appendix B*. While there may be temporary increases or, in certain locations, decreases in forage resources following vegetation treatments, this is not a grazing EIS and no changes to livestock numbers are being considered, nor are any allotments being considered for closing.

Design features to specifically address the need for reseeding in treated areas and minimizing potential spread of noxious and invasive weeds are discussed in the Noxious and Invasive Weeds section and Appendix B.

Table 55. Design Features for Range.

	Trigger	Design Feature	Impact
RG-1	All treatments	Coordinate with District Rangeland Management Specialists prior to developing sale and/or service contracts and/or burn plans to identify and mitigate any potential direct conflicts during implementation. Range personnel will be responsible for incorporating mitigation measures into grazing permittees' Annual Operating Instructions (i.e., a pasture needs to be grazed earlier/later to avoid direct temporal overlap with timber sale activities).	Eliminate or mitigate direct conflicts between implementation activities and range activities.
RG-2	All treatments	Coordinate with District Rangeland Management Specialists prior to treatment to determine whether or not grazing deferment or pasture rest is needed, when deferment or rest is needed (prior to or following treatment), and for how long.	Enhance effectiveness of treatments to meet established objectives

Cumulative Effects Common to All Action Alternatives

Management actions that facilitate the introduction and/or spread of noxious and invasive plants cumulatively impact the quality and quantity of forage for grazing. Active management activities such as timber harvest and subsequent forage condition changes can concentrate use or change livestock use and distribution patterns that may require coordination with range program. Furthermore, ongoing and increased recreation use can influence the distribution of wild ungulates, as well as domestic livestock, on the landscape. The following table displays the foreseeable future actions that are likely to contribute cumulatively to impacts on range, though individual effects may be insignificant.

Present and Future Projects and Activities in the Cumulative Impacts Analysis Area

Agency	District	Foreseeable Future Project
USDA Forest Service	Gunnison	Cochetopa Hills
	Grand Valley	Mesa Point Fuels treatments
	Norwood	Naturita Fuels
	Grand Valley	Resort Mesa treatments
	Ouray	Escalante Forest Restoration treatments
	Gunnison	La Garita salvage treatments
	Ouray	Owl Creek Road Maintance
	Grand Valley	Trickle Park Road improvements and maintenance
	Forest-wide, multiple locations	Trail Management
	Forest-wide	Wild herbivore (elk, deer, moose) browsing and grazing
	Forest-wide	Increased recreation pressure, motorized (four-wheel, ATV-UTV)
	Forest-wide	Increased recreation pressure, mechanized (bicycles)
USDI BLM	Gunnison Field Office	Gunnison Spruce Beetle Response
Colorado Parks and Wildlife	Forest-wide	Increased recreation pressure, non-motorized (pack and foot trails)
Public	Forest-wide	Increased development, creating new WUI
Power and Fuels Companies	Forest-wide, especially Grand Mesa	Construction and maintenance of power line and pipeline corridors
	Several sites across forest	Increased demand for mine and drill facilities
Public	Forest-wide	Deteriorating air quality due to increased population; increases in nitrogen deposition.
Water Provider Agencies	Forest-wide	Water facilities (ditches, reservoirs) construction and maintenance
Ski Area Companies	Forest-wide	Construction and maintenance of ski facilities, including weed control

Silviculture

The GMUG contains approximately 223,000 cumulative acres of spruce beetle mortality and 229,000 cumulative acres of affected aspen accumulated over the past decade, which corresponds to approximately 30% of spruce-fir and aspen on the GMUG. As discussed in Chapter 1, climate change has played a key role in the spruce beetle outbreak. Homogeneous species compositions across large acreages and mature spruce stands with high density have also contributed to the effects. The spruce beetle epidemic has created catastrophic mortality across much of the GMUG in the spruce and spruce-fir forest type and is beyond historic norms (Mask 2013).

Distribution patterns of the primary host species for spruce beetle as well as recent climate change patterns have enabled populations to exponentially expand, which is perpetuating the spruce beetle outbreak across the landscape. Stand structure is modified by spruce beetle.

Spruce beetles lower the species composition, average age and height of the residual stand. Spruce fir forests represent a climax condition, which can be vulnerable to stand replacing epidemics as are currently occurring on the GMUG (Schmid and Frye 1977).

In addition, quaking aspen (aspen) has seen abrupt and extensive die-off across large areas of their range, in response to extreme heat and dryness at the beginning of the 21st century. From 2000 to 2010, roughly 1.3 million acres in the southern Rockies saw significant aspen decline, and regeneration of new aspens has been much lower than normal (Funk et al 2014). Sudden mortality of this magnitude is theorized and documented by forest research scientists to be caused by Sudden Aspen Decline (SAD).

According to the Terror Creek Applied Silviculture Assessment, a critical aspect of SAD is the lack of regeneration by root suckering following a disturbance that kills or removes overstory. The Assessment concluded that aspen forests affected by SAD can be successfully regenerated by clearfell harvesting of overstory trees, provided such harvest is implemented before complete overstory mortality occurs. The treatments identified under the action alternatives in the SBEADMR project attempt to address the effects of both spruce beetle and SAD. The long term goals of management activities are to create forest conditions that will perpetuate forest cover into the future.

Compliance with Regulatory Direction

Forest Service direction guiding this project includes the GMUG National Forest Land and Resource Management Plan (Forest Plan) and amendments, the National Forest Management Act of 1976, the Multiple Use, Sustained Yield Act of 1960, and the Forest Service Handbook (FSH) 2409.26 and FSH 3409.11. The FSH 2409.26 details silvicultural activities permitted on government owned lands within the National Forest System. The FSH 3409.11 is the Forest Pest Management Handbook. This project also follows direction established in the Western Bark Beetle Strategy (USDA Forest Service, 2011i) and the Southern Rockies Lynx Amendment.

Openings from mechanical treatments in affected stands may exceed 40 acres. Per the 1991 GMUG Amended Forest Plan, the maximum size of openings creating by the application of even-aged silviculture is 40 acres (p. III-43); however, larger openings are permitted when the result of natural catastrophic conditions, such as insect or disease attack. Per the National Forest Management Act, Forest Plan maximum size for openings to be cut in one harvest operation shall not apply to the size of openings harvested as a result of natural catastrophic conditions such as fire, insect and disease attack, or windstorm (16 U.S.C. 1604(g)(3)(F)(iv)).

Analysis Methodology

- The inter-disciplinary team (IDT) identified opportunity areas for management based on the Forest Plan.

- All silviculture prescriptions would follow the treatment-specific Design Features
- Direct and Indirect Effects are assessed in a 1 to 5 year time frame; however activities are expected to be implemented over a 10 year time frame. The Direct and Indirect effects would last from the time of implementation up to 15 years later, with the timeframe starting when implementation begins. This is based on selection of an action alternative and assumes all project actions associated with vegetation management would be completed within 15 years after the signing of the Decision by the Responsible Official.
- Vegetation management activities under the action alternative were developed using the following assumptions:
    1. An estimated 60,000 acres of commercial mechanical harvests would be implemented.
    2. For Alternatives 2 and 4, likely mechanical vegetation treatments would be within 1 mile of existing operational maintenance level 3-5 NFS roads.
    3. For Alternative 3, likely mechanical vegetation treatments would be within ¼ mile of existing operational maintenance level 3-5 NFS roads.
    4. Reforestation activities, including residual stocking would comply with the Forest Plan.

Affected Environment

Increased beetle population and decreased resistance due to changed climate and weather patterns has resulted in both increased susceptibility and decreased resistance in individual trees and across large landscapes and geographic regions (See Chapters 1 and 2).

SAD is changing aspen on a landscape as well as stand level, but its effects are more constrained; clonal response varies based on various factors, with moisture stress as an underlying and contributing factor. Moisture deficits have been noted in recent years. SAD has led to loss of aspen cover, and future warm, dry growing seasons are theorized to lead to future occurrences of SAD (Worall et al 2010).

There is likely a linkage between global climate change and the existing condition of vegetation across the GMUG, and within the opportunity areas. Bark beetle populations have increased in response to warmer temperatures and drought conditions (Hebertson and Jenkins 2008). Climate strongly influences productivity, species composition and the frequency and magnitude of forest disturbances (Hauser et al 2009). Recent research indicates SAD occurrence and incidence is changed due to changed climate, specifically changed moisture regime (Worall et al 2010).

Habitat Structural Stage

Habitat structural stage (HSS) is a field verified structural stage (FSVeg User's Guide) that exists as an attribute in a GIS spatial layer. The HSS describes vegetation by type, size and crown cover. The HSS assists in understanding the overall stage of development, as well as size and cover from above and can be useful in determining the overall landscape condition of vegetation.

Table 56. Description of Habitat Structural Stage across the GMUG National Forests (Region 2 FSVeg GIS Layer).

HSS Code	Description	Approximate Tree Size	Crown Cover	Acres
1M*	Grass/Forb, natural meadow	Nonstocked	Not applicable	486,258
1T*	Grass/Forb, previously trees	Nonstocked	Not applicable	29,020
2S*	Shrub-Seedling; not previously trees	Nonstocked	Not applicable	555,573
2T	Shrub-Seedling, previoulsy trees	Less than 1” DBH	Not applicable	13,688
3A	Sapling-Pole	1” to 7” DBH	Less than 40%	152,317
3B	Sapling-Pole	1” to 7” DBH	40-69%	427,711
3C	Sapling-Pole	1” to 7” DBH	70-100%	172,328
4A	Mature tree	Greater than 7” DBH	Less than 40%	193,869
4B	Mature tree	Greater than 7” DBH	40-69%	577,202
4C	Mature tree	Greater than 7” DBH	70-100%	551,473
Not classified				187,784

*Did not fall within the opportunity areas

The habitat structural stage can be directly linked to the successional stages by potential natural vegetation (PNV) types discussed in Chapter 1 in order to create a comparison between the existing condition based on habitat structural stage and the desired condition based PNV successional stages. The following table represents the desired condition by PNV model with a crosswalk between HSS and PNV successional stage:

Table 57. Desired Conditions as per Potential Natural Variation: Crosswalk between Habitat Structural Stage and Successional Stages.

PNV	Early Seral	Early-Mid Seral	Late-Mid Seral	Late Seral
PNV/HSS Crosswalk	2T	3A, 3B, 3C	4A, 4B, 4C	
Spruce-Fir	27-32%	20-24%	12-13%	31-40%
Spruce-Fir-Aspen	13-19%	22-29%	13-16%	35-49%
Aspen	8-14%	23-26%	17-24%	23-43%

Vegetative desired conditions will sustain all PNV types that exist on the GMUG through balancing habitat structural stages through active forest vegetative management.

The HSS figures shown in Table 56 and Figure 34are not restricted to the vegetation types that would be affected under the alternatives and considers all vegetation types across 3,347,233 acres of the Forest. The HSS analysis of the Forest shows a lack of early and mid-seral vegetation; conditions created by spruce beetle and SAD. Mid and late seral forest conditions provide ample habitat for spruce beetle. In the case of SAD, lack of early seral aspen has created conditions that perpetuate aspen decline, as the aspen across the landscape are generally mid-seral. Added environmental stressors, such as lack of moisture, changed weather patterns, and overall climate shifts affect larger areas since the age, size, and maturity of aspen across the landscape is generally similar.

The distribution of size and density is skewed toward larger trees with higher amounts of canopy cover across all vegetation types, meaning that most of the stands on the GMUG are comprised of older trees, which are generally larger. Large acreages of vegetation in this condition is at risk to loss, as disturbance events, including insects, disease and effects of climate occur.

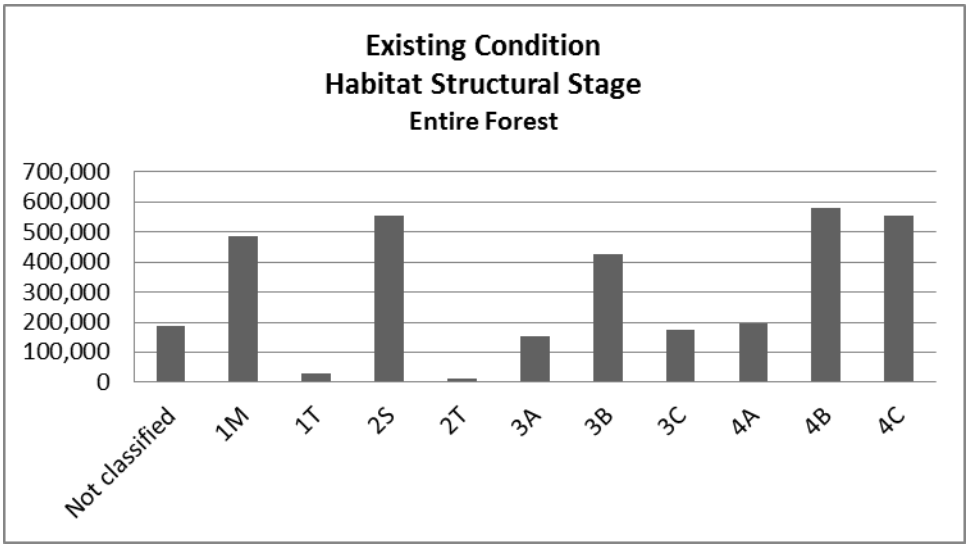


Figure 34. Habitat Structural Stage across the Forest from the FSVeg GIS Layer.

Alternative 1 (No Action) – Direct and Indirect Effects

No vegetation management activities would occur as a result of the No Action alternative. There would be no treatments to address safety, recovery or resiliency. As a consequence of no action, the spruce and aspen that have been killed would remain on site. Standing dead trees as well as downed trees change local site conditions. More material that remains on site may affect natural regeneration success, as the seedlings require access to bare mineral soil to become established (Uchytil 1991). Based on current stand conditions, research and field observations, the effects of spruce beetle would continue across the entire GMUG and within and outside of the opportunity areas.

Changes in stands that are in dense, specifically outside of pure aspen stands would likely continue to be affected by spruce beetles. The spruce stands with higher densities are generally at higher risk, and this risk would continue in the no action alternative. Due to the unprecedented nature of the current attack, all stands have the potential to succumb to mortality. The spruce beetle attack would likely continue due to the population that currently exists. The numbers of beetles are high enough that they will likely perpetuate the current attack until the spruce tree that they use for habitat is no longer available.

Over time, standing trees would fall to the ground. Large amounts of downed trees would cover soils. Natural regeneration would be less predictable if site conditions were not such that bare mineral soils exist for a seedbed and germination. Increased fuel loading may lead to increased fire hazard. If a fire were to occur, live spruce trees that are not affected may be susceptible to mortality from fire, as spruce is a fire sensitive species (Uchtyil 1991). Canopy cover would continue to decrease as both aspen and spruce trees die.

The number of dead trees would continue to increase in the short term. Over time, snags would fall to the ground and downed woody debris would increase. Windthrow risk may increase as stand structures change and individual trees become less windfirm. Species composition may shift as natural succession occurs. Engelmann spruce is considered a climax species in sub-alpine forests of this region (Uchytil 1991).

Natural succession processes in spruce dominated stands may result in colonization of the site by other tree or shrub species that are present. Shade intolerant species are likely to increase due to loss of mature trees. Over time, stands in high mortality areas would begin the stand initiation phase, provided adequate seedling establishment. Over time, there would be an overall increase in age class diversity across the affected landscape. Spruce fir stands with a significant component of fir may have a greater composition of fir over the long term (Schmid and Frye 1974).

Aspen forest types can be either early seral or stable aspen communities. Seral aspen communities often have a significant component of conifers present, suggesting that conifers will eventually overtake the aspen and the stand type will become conifer dominated. Stable aspen communities may have occasional conifers present, but the aspen community will persist over time (Debyle and Winokur 1986). Under the No Action alternative, SAD affected stands that are not stable aspen communities may be replaced by conifers and conifer forest types would dominate the once seral aspen stands.

Alternative 1 – Cumulative Effects

There are no proposed management activities under Alternative 1. Therefore, no change to silviculture would result from the implementation No Action Alternative. However, the direct

and indirect effects of natural processes in combination with past, ongoing, and future activities could result in cumulative effects to silviculture.

Current and future vegetation management activities authorized by other decisions are noted in the table below.

Agency	District	Foreseeable Future Project	Impacts within the range of those described in direct and indirect impact (Yes/No) and effects analysis and additional comments.
USDA Forest Service	Gunnison	Cochetopa Hills Vegetation management	Yes
	Grand Valley	Mesa Point Fuels treatments	Yes
	Norwood	Naturita Fuels	Yes
	Grand Valley	Spruce Beetle SAD treatments	Yes
	Grand Valley	Resort Mesa treatments	Yes
	Ouray	Escalante Forest Restoration treatments	Yes
	Gunnison	La Garita salvage treatments	Yes
USDI BLM	Gunnison Field Office	Gunnison Spruce Beetle Response	Yes

Under the No Action Alternative, aspen is anticipated to continue to decline as future climate change events occur. This trend was noted during most recent moisture stress, and stands affected by SAD show significant declines in suckering. Bio-climate modeling that was conducted during the recent SAD outbreak show that the trend is toward loss without changing of age class and structural diversity across the landscape. There is a projected decrease in overall aspen suitability in areas that have less effective moisture and are generally warmer and drier. Complete loss of aspen may occur in some lower-elevation sites and on south slopes, while at the other extreme, aspen habitat would persist and may become newly suitable at higher elevations and north slopes (Worrall 2013). Clear-felling techniques that promote suckering would not occur. In stands affected by SAD and absent regeneration treatment, there is the potential for complete loss of the stand (Shepperd, Smith, and Pelz 2015).

In spruce-fir, where seed sources are lacking, there would be less regeneration of spruce-fir. These impacts would be compounded in the context of a changing climate that is rendering lower elevation spruce-fir habitat less suitable for the species to persist and re-establish.

Direct and Indirect Effects Common to All Action Alternatives

This section is a qualitative discussion of the effects of management actions that would occur across all the action alternatives. Due to the adaptive nature of this project and the ongoing effects of the change agents – spruce beetle and SAD, quantification of these effects through numerical or other measures would not be meaningful to the analysis.

Hazard Tree Removal

Hazard tree removal may be significant in some forested areas, as the amount of mortality is extensive in some areas where the spruce beetles and SAD have killed many trees. Hazard trees would be removed to accomplish safety objectives as outlined in the 2011 Western Bark Beetle Strategy. Quantification of the amount of hazard tree removal is difficult, as the epidemic is ongoing. The removal of hazard trees would be focused on areas that have human use, and so the effect will be primarily in that area. Depending on the level of mortality in an area, there may be a few individual trees removed where there are small amounts of affected trees. For areas where the removal is incidental, there will not be a measurable change to basal area, canopy cover nor will the overall density of the stand change a measurable amount.

In areas where there is significant mortality, a substantial amount of hazard trees could be removed. These areas would have significant changes to the following: basal area (reduced residual stocking), canopy cover, and stand density.

Non-commercial Treatments

Non-commercial treatments would primarily consist of broadcast burning or other stand treatments that would assist in meeting overall project fuels reduction goals. The effects of this type of treatment are discussed in more depth in the project fuels report.

Prolific aspen regeneration results from application of fire, as there is a complex hormonal control that exists in aspen making it almost ‘fire dependent’ on some sites (Howard 1996). Aspen can also regenerate without fire, and this is entirely dependent on aspen genetics as well as site. The effects of fire burning through heavy fuels on aspen clone roots is not well documented in the literature, but it is suspected that aspen clone roots are generally insulated enough by soil to survive and sucker in fuel loadings as high as light slash.

In clones where fire is prescriptively applied, the anticipated effect of broadcast burning is consumption of surface fuels and mortality of any remaining aspen stems and stems of non-fire-adapted species. This would then result in a flush of new aspen growth, suckering and other stand responses that are desirable and that would perpetuate the clone for a long period into the future. This would also result in a reduction of shade-tolerant, non-fire adapted species in the stand. Overall, the application of broadcast burning in aspen would be relegated to clones that would benefit, and avoided where fire would be a detriment. This would be decided by a

certified silviculturist and qualified fuels manager. The effects would be generally positive, and provide a net benefit to aspen in the immediate and through time.

If stands were burned where some spruce were present, it is likely they would be eliminated from the stand. Spruce is not a fire adapted species. Spruce is very fire sensitive and is generally killed even by low-intensity fires. Post fire reestablishment is via wind-dispersed seeds which readily germinate on fire prepared seedbeds (Uchytil 1991). Broadcast burning may also reduce natural regeneration success, depending on the timing and intensity of the fire prescription. The effects of broadcast burning some residual slash from spruce salvage in stands where aspen is present or one of the most dominant species, would likely result in some mortality of any still-living aspen stems and prolific suckering of aspen, except under areas of very high slash fuels or slash piles.

Lynx Analysis Units

Suitable lynx habitat is framed in context of LAUs, and so for the purposes of this vegetation analysis, timber will be the only resource quantified or described by ‘suitable’ or ‘unsuitable.’ The terms may be used differently in the wildlife section of this EIS.

Alternative 2 may treat areas in LAUs by methods outlined in Appendix A. Treatment methods would vary based on stand condition and cover type. Treatment has the potential to affect ‘suitable’ lynx habitat. Geoprocessing work done provided an outline by District and LAU of the potential opportunity areas within LAUs that was also within suitable lynx habitat. This is for spruce only; aspen is not included. The proposed action includes the focus LAUs where commercial mechanical treatments could occur.

Lynx Analysis Units

Suitable lynx habitat is framed in context of LAUs, and so for the purposes of this vegetation analysis, timber will be the only resource quantified or described by ‘suitable’ or ‘unsuitable.’ The terms may be used differently in the wildlife section of this EIS.

Alternative 2 may treat areas in LAUs by methods outlined in Appendix A. Treatment methods would vary based on stand condition and cover type. Treatment has the potential to affect ‘suitable’ lynx habitat. Geoprocessing work done provided an outline by District and LAU of the potential opportunity areas within LAUs that was also within suitable lynx habitat. This is for spruce only; aspen is not included. The proposed action includes the focus LAUs where commercial mechanical treatments could occur.

Table 58. Alternative 2 Opportunity Areas as Classified by Suitable Timber Land in Suitable Lynx Habitat.

Ranger District	Total potential acres	Recovery treatments-potential acres	Resiliency treatments-potential acres
Grand Mesa	47,583	23,792	23,792
Gunnison	139,917	111,934	27,983
Paonia	7,493	3,747	3,747
Ouray	30,279	15,140	15,140
Uncompahgre	17,195	8,598	8,598
Total Acres	242,467	163,209	79,258

Alternative 4 is the salvage only option. These acreages include areas where commercial mechanical treatments would occur in spruce only. No resiliency treatments would be implemented.

Table 59. Alternative 4 Opportunity Areas as Classified by Suitable Timber Land in Suitable Lynx Habitat.

Ranger District	Total potential acres	Recovery treatments-potential acres
Grand Mesa	92,024	46,012
Gunnison	204,526	163,621
Paonia	9,464	4,732
Ouray	48,932	24,466
Uncompahgre	92,544	46,272
Total Acres	447,490	285,103

These tables show the total acres of opportunity acres that exist by ranger district that could have recovery or resiliency treatments applied. This is not the amount of acres that would be treated. On the Gunnison Ranger District, the GMUG assumes that 80% of the potential acres would be treated by the recovery prescription, and 20% would be treated by the resiliency treatment. The GMUG assumes that for other Districts, 50% of the potential acres would be treated by the recovery prescription and the other 50% would be treated by the resiliency prescription.

The total acres that would be treated through the lifetime of the project are approximately 60,000 commercial and 40,000 to 60,000 acres non-commercial. The table above shows that of the acres proposed for treatment under Alternative 2, there are substantially greater amounts of acres that would not be treated, and would remain in the existing condition. The project wildlife report further describes and discusses what LAU treatment means in context of lynx habitat.

Prescription Effects for Indicator Measures

This section outlines the effects of the prescriptions from Appendix A, Silvicultural Prescription Matrix.

The effects analysis of the indictor measures addresses from Lowest to Highest how the indicators change across the spruce fir structural stand conditions. This is how the indicators are ranked:

1. Lowest
2. Lower
3. Low
4. Moderate
5. High
6. Highest

This ranking system defines the spatial complexity of the stands in terms of categorizing the various indicator measures; the spatial complexity of stands is then factored into the larger landscape. Since the spruce beetle epidemic is landscape level and considered 'catastrophic' the amount of stands that have moderate to high complexity post treatment will be limited.

Table 60 below, outlines how the indicator measures compare to each other by stand conditions and prescription across those described in the matrix, Appendix A. In general, multiple canopy layers have the highest complexity on a stand level, with the indicators changing by prescription from highest to lowest as the prescription increases as the amount of tree cover removed increases (resiliency →recovery and resiliency →recovery). Two-storied stands are less complex, with fewer canopy layers, than multiple storied stands, and so the indicator measures change appropriately based on the lower complexity. Single storied stands are least complex, and so have the lowest overall diversity of the indicator measures.

Table 60. Spruce Fir and Spruce / Spruce Mix Prescriptions and Anticipated Effects by Indicator Measure.

Spruce fir structural stand condition	Indicator	Resiliency	Recovery and Resiliency	Recovery
Single storied	Age class	Lower	Lowest	Lowest
Single storied	Species composition	Lower	Moderate - Low	Moderate
Single storied	Vertical structure	Lower	Lowest	Lowest
Single storied	Horizontal strucutre	Lower	Lowest	Lowest
Two storied	Age class	Moderate	Moderate-Low	Lowest
Two storied	Species composition	Moderate	Moderate	Moderate
Two storied	Vertical structure	Moderate	Moderate-Low	Lowest
Two storied	Horizontal strucutre	Moderate	Moderate-Low	Lowest

Spruce fir structural stand condition	Indicator	Resiliency	Recovery and Resiliency	Recovery
Multiple canopy layers	Age class	Highest	High-Moderate	Low
Multiple canopy layers	Species composition	Highest	Moderate	Low-Moderate
Multiple canopy layers	Vertical structure	Highest	Moderate	Low
Multiple canopy layers	Horizontal strucutre	Highest	High-Moderate	Low

The indicator measures are in context of group selection, matrix and clearcutting that could be applied. The type of treatment as well as amount of acres treated will vary based on the existing condition. When considering the indicator measures at a stand and landscape level, various types of patterns emerge. These patterns are influenced by the scale, size and distribution of disturbance patterns. For spruce beetle, the disturbance that is addressed in this report is catastrophic, and beyond historic norms.

Oliver and Larson (1996) capture patterns of species and dominance by categorizing forests by these general terms:

1. *Stand initiation stage.* After a disturbance, new individuals and species continue to appear for several years.
2. *Stem exclusion stage.* After several years, new individuals do not appear and some of the existing ones die. The surviving ones grow larger and express differences in height and diameter; first one species and then another may appear to dominate the stand.
3. *Understory reinitiation stage.* Later, forest floor herbs and shrubs and advance regeneration appear and survive in the understory, although they grow very little.
4. *Old growth stage*. Much later, overstory trees die in an irregular fashion, and some of the understory trees begin growing into the overstory.

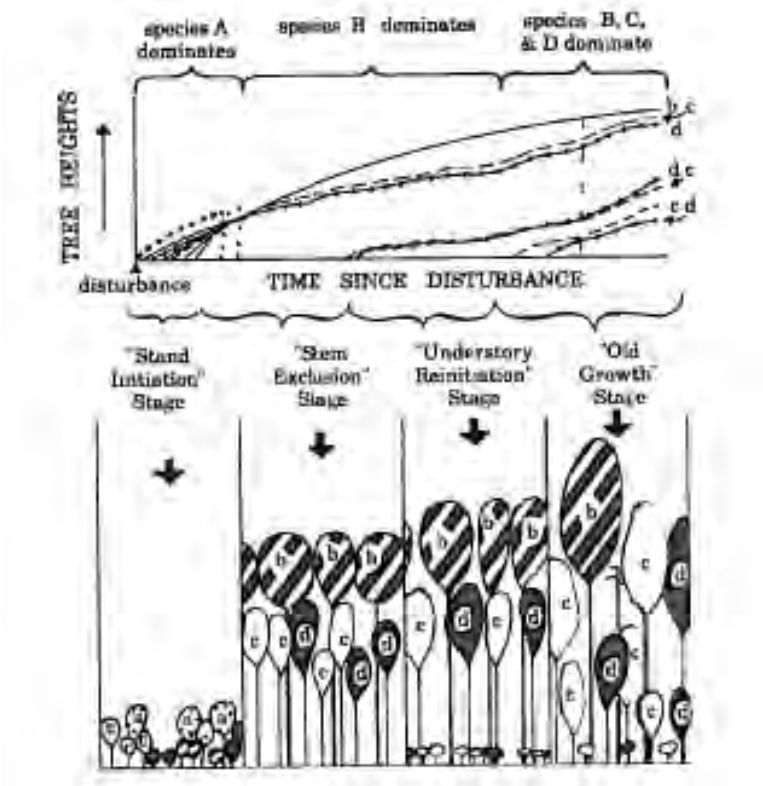


Figure 35. Schematic stages of stand development following major disturbances (Oliver and Larson, 1996).

Using Oliver and Larson (1996) stages of stand development following major disturbances,

Table 61 categorizes the stand structural stages post treatment that would be possible under the various prescriptions from Appendix A, Silvicultural Prescription Matrix. Stand type defines the structural complexity, with single storied stands having the lowest complexity pre-treatment. Post treatment, the stand complexity remains lowest. Two-storied stands have higher structural complexity, but these areas are still unable to support the 'old growth' stage as defined by Oliver and Larson (1996) due to a lack of structural complexity.

Table 61. Categorization Of Stand Structural Stages, Post Treatment, Based on Oliver and Larson (1996).

Spruce fir structural stand condition	Prescription type	Resiliency	Recovery and Resiliency	Recovery
Single storied	Group selection	Understory re-initiation	Stand initation	Stand initiation
Single storied	Matrix	Understory re-initation	Stand initation; understory re-initation	Stand initation
Two storied	Group selection	Understory re-initiation	Stand initation	Stand initation
Two storied	Matrix	Understory re-initation; stem exclusion	Stand initation; understory re-initation	Stand initation
Multiple canopy layers	Group selection	Understory re-initiation	Stand initation	Stand initation
Multiple canopy layers	Matrix	Old growth; undestory re-initation; stem exclusion	Stand initation, understory re-initation; stem exclsuion (limited)	Stand initation

The existing condition of the stands before beetle attack has a significant influence on the different stages of development that can exist post-treatment. Stands that are in a less complex structural condition (single storied) are in a pre-treatment condition where their vertical and horizontal structural complexity is low.

Spruce Fir Prescriptions

Under the action alternatives, the effects to the indicator measures for spruce are anticipated to have the following effects, by prescription type. Objectives for each type of treatment are identified in Appendix A, Silviculture Prescription Matrix. The effects to the indicators are based on meeting the identified objectives for each prescription type.

Resiliency treatments would be implemented to remove beetle affected trees in the matrix areas, as well as group select pockets of dead and dying trees. Resiliency treatments would be applied in areas where there is less than 40% overstory mortality. Group selection size would vary from ¼ to 2 acres in size, with 15% to 25% of the total stand area being group selected. Matrix areas would harvest no more than 40% of the existing stand stocking, to assist the residual stand in resisting blowdown (increased stand level ‘wind firmness’). High elevation stands in mountain environments can be subject to blowdown as species rooting depths can be shallow, and soil moistures can be high. These factors coupled with mountain winds can create substantial occurrence and risk of blowdown.

Recovery and resiliency treatments would be implemented in areas with 40 to 90% overstory mortality. In these areas, group selection, clearcutting, or matrix thinning could be applied. The recovery and resiliency treatments would address stands that have extensive mortality, but still have a small live tree component.

Recovery treatments would be implemented in areas where there is over 90% mortality. This prescription would implement clearcutting where mortality is extensive; this would be the prescription that would remove the greatest tree component.

Appendix A further describes three stand conditions that could be encountered during field implementation. These are: single-storied, two storied, and multiple canopy layers. The effects to wildlife (Lynx) will be further addressed in the wildlife section of this EIS.

The recovery treatments will allow for the greatest flexibility for forest managers to deploy proactive strategies designed to respond to a changing climate and increase capacity of ecosystem resistance and resilience (Scholes et al. 2014). The recovery treatments can be focused on areas of the forest where ecosystem vulnerability is the greatest (Rehfeldt et al. 2015). These areas represent potential treatment areas where a shift in species composition could occur to reduce long term vulnerability and increase overall resilience at the landscape scale.

Tree Planting would occur following recovery treatments on stands that do not have sufficient natural regeneration to be certified as fully stocked. Tree species and stocking levels of planting will be based on stand biophysical attributes. It is estimated that planting will occur on 1700 acres a year in the Gunnison basin and 750 acres a year outside the Gunnison basin.

Discussion of Indicator Measures (Spruce)

Age Class would vary by treatment method across the stand. In the short-term time frame, areas that are group selected would be in the understory re-initiation phase (Oliver and Larson 1996). In the long term time frame, the group selection areas would transition to the sapling and pole stage, with the oldest trees in group selection areas being approximately 20 years old. Group selection areas would be re-forested as required by the 1991 Forest Plan, to appropriate stocking standards. For the group selection treatment type within the short term time frame, trees would be seedlings. In the long term time frame, there would transition to older trees, but would not exceed 20 years of age.

Matrix areas that are outside of the group selection areas, but within the larger stand treatment boundary would have small areas that could be in the stand initiation phase in the short term time frame. This would occur only if natural regeneration resulted, as matrix thinning would not reduce stocking below 40% of present stocking, and so would not require planting. Matrix areas would generally have trees that are in the sapling, pole and sawlog size classes. The matrix areas

would have higher age class diversity than group selection areas. Places not affected by spruce beetle may have high age class diversity, with the stem exclusion, understory reinitiation, and old growth stages present. These types of stands would be restricted to areas that have generally not seen spruce beetle activity and would be extremely limited on the landscape due to the magnitude of the current outbreak.

The group selection and matrix areas combined in the larger stand would exhibit the highest level of age class diversity under the resiliency prescription than under recovery and resiliency or resiliency prescriptions. This is because the existing stand, pre-treatment, has had the least overall negative effects from the spruce beetle epidemic; stand level mortality is less pre-treatment than in other scenarios, which provides for greater age class diversity in the short term and long term time frame.

Variable retention regeneration treatments would occur during resiliency/recovery and recovery treatments. Stands treated with these treatments will be certified as fully stocked within five years of harvesting either by natural regeneration or artificial regeneration. These stands will be considered openings by forest plan standards following harvest till approximately 20 years into the future.

Species Composition: Species composition is likely to be highest under the resiliency prescription, compared to the recovery and resiliency, and recovery prescription. Since the recovery prescription would be applied to stands with less than 40% overstory mortality, this prescription would be applied to stands that have the highest level of stand-level and local diversity. Low mortality is likely to result due to species being present that are not susceptible to spruce beetle or areas that have not seen the outbreak yet.

Most trees in the spruce / fir mix are susceptible to spruce beetle attack, so the amount of stands with high levels of species composition are very limited. Though species composition is likely to be highest under the resiliency prescription, the number of stands that have high levels of trees that are not host species for spruce beetle is limited. Spruce beetle is adapted to utilize most trees within the cover types affected, which is one factor that is contributing to the landscape and regional effects.

Variable retention regeneration treatments would occur during resiliency/recovery and recovery treatments. Stands treated with these treatments, which are geographically located in areas mapped as lost according to Rehfeldt et al. 2015, represent potential areas where species composition could be shifted which would result in increased species diversity across the landscape.

Vertical Structure: Vertical structure would be greatest under the resiliency prescription. Stands that are in a condition to have this prescription applied would have less mortality than other

stands; this factor alone increases the amount of vertical structure, as it indicates that the stands where resiliency would be applied are at decreased incidence of spruce beetle attack.

Multiple canopy layers would have the greatest overall amount of vertical structure, with two storied stands being next. Single storied stands would have low amounts of vertical structure. Considering all of the stands in context, those with resiliency prescriptions applied that are multiple canopy layers would have the greatest amount of vertical structure in all the treatment scenarios. This is likely the highest quality wildlife habitat that would be available across the landscape.

Horizontal Structure: Under the resiliency prescription, stands that are selected for treatment would have greater amounts of horizontal structure than under the recovery and resiliency prescription. The recovery prescription would have the least amount of horizontal structure. The resiliency prescription results in a greater amount of horizontal structure than the other prescriptions, as the stands are in a better condition pre-treatment; this, combined with the combination of group selection and matrix thinning, results in high levels of horizontal structure within the treated stand.

Aspen Prescriptions

Coppice cutting is the method of cutting that would be implemented in aspen. Broadcast burning may be utilized to increase suckering potential post treatment. Even-aged management would be implemented in aspen stands. Aspen prescriptions will incorporate recommendations outlined Sheppard 1993 and Johnston 2001.

Discussion of Indicator Measures (Aspen)

Age Class: Coppice cuts would remove all the trees, which would create a new age class of trees. In the short-term time frame, areas that are harvested would be in the stand initiation phase. In the long-term time frame, the harvested areas would transition to the sapling and pole stage, with the oldest tress being approximately 20 years old. In aspen in the short term-time frame, trees would be seedlings. In the long term time frame, there would transition to older trees, but would not exceed 20 years of age during the long term time frame.

***Species Composition*:** The harvested areas would likely remain as aspen, as they are a clonal species and as such would re-sprout. In areas where the clone is weakened and severely affected by SAD, a different species may colonize the area and would likely be conifer rather than deciduous tree. There is a possibility that species other than conifers could colonize the site if the aspen clone no longer existed; wetter areas may see riparian species colonize.

Vertical Structure: Vertical structure would be very low in the short-term time frame, and would increase gradually over the long-term time frame. Even-aged management would remove

the standing trees, which would result in virtually no vertical structure within the treated areas. Over time, these trees would regrow and vertical structure would increase.

Horizontal Structure: In the short-term time frame, horizontal structure within the treated stand would be low, and would remain somewhat low during the long-term time frame. Horizontal structure could increase significantly outside of the treated areas. Across the landscape, horizontal structure would be greater if the areas that have been affected by SAD and spruce beetle are less; many aspen stands are at an elevation that is below spruce fir. In these areas if the adjacent stands are not spruce dominated, and have not been affected by spruce beetles, horizontal structure could be much higher.

Design Features

Design features would be incorporated into the implementation of the action alternatives as a means to comply with applicable laws, regulation, policy and other guidance. Silviculture design features are noted in Table 62 and Appendix B. Design features for silviculture are intended to reduce and limit potential effects to the vegetation resource and consider the long term productivity and maintenance of the forest; recover a live tree component in stands heavily affected by spruce beetle and SAD; to keep forest areas forested in the near future as well as through time.

Table 62. Design Features Related to Silviculture

Number	Design Feature	Citation
SV-1	All regeneration cutting will meet stocking standards as defined in the Forest Plan.	1991 Forest Plan
SV-2	All vegetation treatments, including prescribed fire, will be prescribed by a U.S. Forest Service, Region 2, Certified Silviculturist in accordance with applicable guidance from other resource specialists.	FSH 2409.17 Silvicultural Practices Handbook
SV-3	To the greatest degree practicable given site fuels conditions, jackpot and pile burning would be used as acceptable methods to assist with natural regeneration strategies. Burning could be prescribed to create mineral soil seedbeds for natural regeneration. Harvested areas would be evaluated for stocking.	R-2 FSH 2409.17 Silvicultural Practices Handbook

Number	Design Feature	Citation
SV-4	During site preparation or piling activities, mineral soil exposure will be less than 40% of the treated area. Soil cover should be retained when practicable. To assist natural regeneration, conduct vegetation and fuels management activities to average 20 - 40% mineral soil exposure in post-harvest, as prescribed in the stand management prescription. On south slopes, mineral soil exposure would be less so that site moisture can better be retained If the area has been identified as being high risk for invasive plants, or is known to have existing infestations, reduce soil exposure and consider artificial regeneration practices (planting).	Alexander 1987
SV-5	In order to reduce the risk of spruce beetles being drawn to uninfected trees, in stands with a component of live spruce which are not beetle-infected, felled spruce shall be removed from the sale area by no later than October 31 of the year felling occurs and unutilized spruce material (in excess of the 10-20 tons/acre required by the Forest Plan) that is cut during operations and greater than 6" diameter at the small end, but is not merchantable and left on site could be removed from the stand and taken to the landing. This will be considered yarding of un-merchantable material (YUM). When removal of non-merchantable material (YUM) is operationally infeasible, material would be debarked in stands, chipped or otherwise treated within the stand to reduce the likelihood of the material being utilized as brood material. Treatment of non-merchantable material will be prescribed by a certified silviculturist based on treatment-specific conditions, with the overall goal being to reduce brood material.	Professional judgment of Forest silviculturists and Forest Health Protection Staff.
SV-6	During any types of harvest in spruce-fir, pockets or areas of advanced regeneration will be avoided to the greatest degree practicable to protect advanced regeneration.	Southern Rockies Lynx Amendment, Professional judgment and standard operating procedure.
SV-7	Broadcast burning for regeneration of spruce-fir stands should be limited to salvage operations in stands with almost total spruce mortality where limited advanced regeneration is left, or anticipated to be left after harvest in order to avoid negative impacts of fire to live spruce. Targets for broadcast burning for regeneration in salvage harvested spruce-fir stands would be creating patches of exposed mineral soil in up to 40% of the area to allow for spruce seed establishment mixed with some large residual material to provide shade to seedlings and seed sources within 300 feet of a majority of the unit. If the area has been identified as being high risk for invasive plants, or is known to have existing infestations, reduce bare mineral soil exposure and consider artificial regeneration practices (planting).	Professional judgment of Forest silviculturists, Fire Effects Information System, Kilgore and Curtis 1987.

Number	Design Feature	Citation
SV-8	In stands managed for aspen regeneration: a. Treatment units > 20 acres are preferred, to lessen effects of big game and livestock browsing. Treatments may exceed 40 acres. b. Minimize soil compaction by heavy equipment and haul trucks. c. Confine aspen treatments to suitable soils as much as possible. d. Give preference to sites in threatened and persistent aspen habitat zones (Worrall 2013). e. Use clear-felling (with fire as appropriate) to regenerate aspen stands for increased landscape resilience. f. Choose timing of treatments, appropriate to recent extreme weather events.	Johnston 2001, Worrall 2013, Worrall et al. 2013

Alternative 2 (Proposed Action) – Direct and Indirect Effects

Of the total opportunity area for the Proposed Action, the EIS analyzes a maximum of 120,000 acres of commercial and noncommercial treatments over the approximately 8-12 year implementation timeframe of the project.

Treatment methods used would consist of: 1) commercial mechanical treatment, which is ground-based mechanized timber cutting on lands suitable for timber harvest that produces a commercial product, 2) non-commercial mechanical treatment, which is ground-based mechanized timber cutting that does not produce a commercial product, and includes use of mechanized equipment for tree cutting, mastication, and hand treatments using chainsaws; and 3) prescribed fire, which includes broadcast burns and pile burns.

The proposed action was developed to respond to the damage agents that are acting on the forest stands. The proposed action is specifically intended to address treatment of the forest stands to respond to the catastrophic spruce beetle epidemic, as well as SAD, and helps move the project area towards desired conditions described in the Forest Plan.

Table 63 shows the HSS by tress species and suitability for Alternative 2. The HSS shows a skewed distribution toward the larger trees, with higher overall canopy cover.

Table 63. Habitat Structural Stage by Tree Species and Suitability for Alternative 2, Pre Spruce Beetle Epidemic (FS Veg).

Species	Suitability	Habitat Structural Stage							Acres by tress species
		2T	3A	3B	3C	4A	4B	4C	
Aspen (mixed with other non-spruce types)	Suitable	2,418	6,072	24,486	15,617	6,521	40,750	20,323	116,187
	Unsuitable	501	14,635	31,371	20,114	7,994	37,821	26,548	138,984
Aspen/Spruce Mix	Suitable	224	3,571	16,924	4,550	2,055	28,421	30,387	86,132
	Unsuitable	95	3,621	17,623	3,526	2,941	17,469	15,923	61,198
Spruce /Spruce Mix	Suitable	143	5,138	13,590	2,909	5,806	36,968	29,361	93,915
	Unsuitable	65	2,816	8,102	3,955	8,863	25,755	29,824	79,380
Sub-total Acres	Suitable	2,785	14,781	55,000	23,076	14,382	106,139	80,071	296,234
	Unsuitable	661	21,072	57,096	27,595	19,568	81,045	72,295	279,563
Total Acres		**3,447**	**35,853**	**112,096**	**50,671**	**33,950**	**187,183**	**152,366**	**575,567**

The distribution of size and density is skewed toward larger trees with higher amounts of canopy cover across all vegetation types, meaning that most of the stands on the GMUG are comprised of older trees, which are generally larger. Large acreages of vegetation in this condition is at risk to loss, as disturbance events, including insects, disease and effects of climate occur.

Suitable lands would be primarily treated under the Proposed Action, and the unsuitable lands would not receive treatment other than for fuels, unless a safety hazard exists. Therefore the effects of vegetation removal to the suitable lands would be greater than on the unsuitable lands.

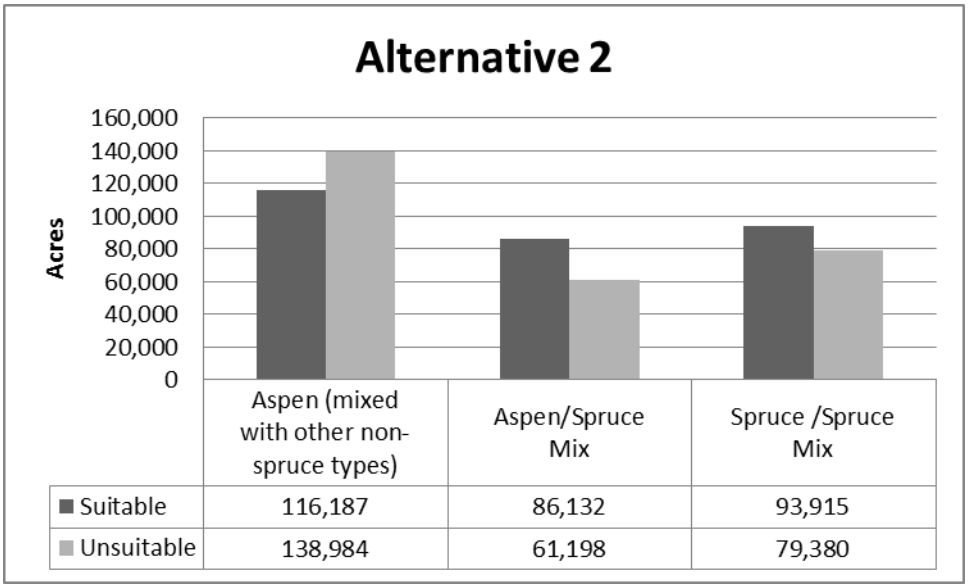


Figure 36. Existing condition pre-spruce beetle epidemic with Alternative 2 suitable and unsuitable acres.

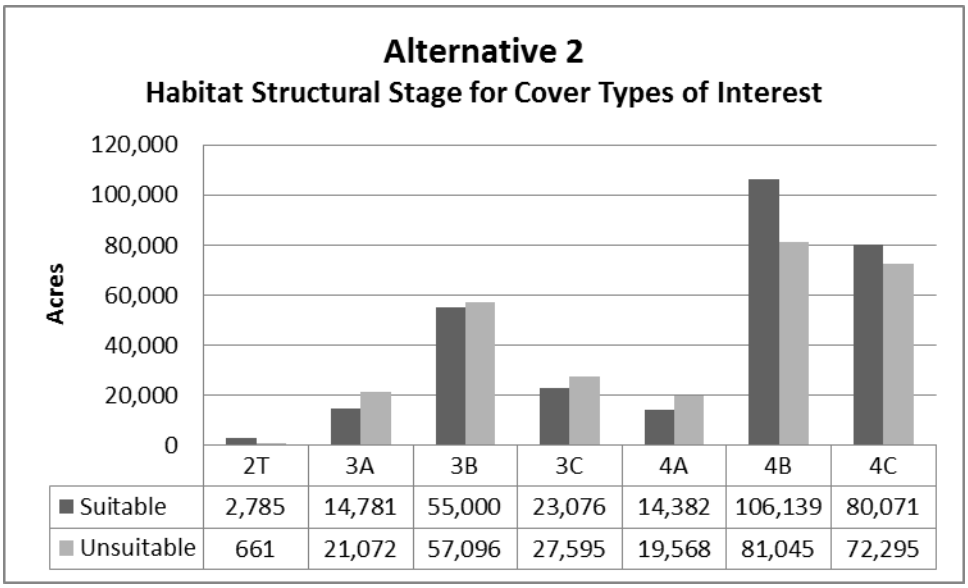


Figure 37. Alternative 2. Existing condition pre-spruce beetle epidemic, habitat structural stage and suitability.

Under Alternative 2, resiliency treatments would effectively reduce the amount of standing live trees by use of group selection. Areas that are group selection harvested would then be regenerated and a new cohort of seedlings would be established. Group selection areas would be

less than two (2) acres in size. Recovery treatments would remove trees that have been killed or will die within a very short timeframe. This would lead to fewer numbers of standing snags across the landscape, with fewer left in the treated units. Across the landscape there would a significant amount of snags remaining due to the fact that such a small portion of the affected landscape would be treated. There would be a reduction to downed woody debris in the immediate and over the longer term in the treated stands that are either aspen or spruce. The reduced amount of downed wood in the treated stands would likely lead to greater establishment of natural regeneration, provided seeds existed on site.

Dense stands would likely continue to be affected by spruce beetles. Alternative 2 resiliency treatments may change this trajectory, however, due to the current population of spruce beetles it is unknown as to how significant the change could be. Bark beetle activity is not generally curtailed until the population entirely exhausts available live trees. The beetle will not disappear until the host species are exhausted. Treated areas would be reforested; this would not occur under the No Action alternative.

Recovery and resiliency treatments are intended to assist with providing the best options for a future forest, not necessarily to stop beetle activity. The epic scale of the outbreak has foreclosed some options that existed prior to infestation. Recovery and resiliency treatments will be focused on late seral successional stages and tend to balance the landscape across all successional stages by managing the stands through the stand initiation stage into stem exclusion. Within this alternative there are approximately 72,000 acres that have been mapped as areas where species conversion could occur if recovery treatments are identified.

Spruce is considered a moderate to good seed producer (Uchytil 1991). Natural regeneration strategies would be used when possible (see Silviculture Design Features). In areas that have been treated, planting desirable species could more readily be accomplished, as the site would be prepared. Removing dead trees would also assist successful natural regeneration, as sunlight would reach the seedlings more readily and dead trees would not be on site to fall on to the newly established seedlings.

Aspen treated by mechanical and / or broadcast burning would facilitate persistence of aspen where it is a stable aspen community. In seral aspen communities, the stand composition may shift to greater conifer presence. Treatment intensity has a significant effect on aspen response as aspen is a clonal species and much of the response to management varies depending on the clonal genetics, location, and other environmental factors. Under Alternative 2 there would be greater age class diversity across the landscape. Management under the Proposed Action would result in younger aspen on the landscape, which may help to perpetuate aspen into the future (Worrall 2013).

Spruce beetles would likely continue to impact spruce trees, as the population of beetles is high enough that they will continue to move into areas that have not been affected in an effort to perpetuate themselves. The resiliency treatments would break up the continuity of the available mature spruce trees, so this would assist developing age class diversity, which may curtail future activity in the relatively small areas where resiliency treatments will occur. Mature 'old growth' spruce may not effectively be protected as it is most susceptible to beetle attack. However, resiliency treatments may assist in recruitment of old growth due to the design of the treatment, as the overall intent is to protect some component of the current green stands, so that they can be perpetuated into the future and provide for regeneration and future forests. Recovery treatments would allow stand re-initiation which would indirectly increase the amount early and mid-seral successional stages over the next 20 to 30 years contributing to a balanced range of successional stages across the landscape.

Aspen that is treated by clearfelling would result in suckering, which would establish a new age class of trees. On a landscape scale, this would assist in creating age class diversity. Aspen clones that are not mature have less overall susceptibility to the effects of SAD, and greater resilience during subsequent climate and other disturbance events.

Alternative 3 (Public Safety Focus) – Direct and Indirect Effects

Alternative 3 focuses on protection of community infrastructure and public safety. Under Alternative 3, all treatment types and methods would remain the same as in Alternative 2, but would be limited to the identified opportunity area. Alternative 3 encompasses the least acres of all the action alternatives. The alternative has approximately 92% of the opportunity areas in HSS that are high density (3B, 3C, 4B,C) areas.

Table 64. Habitat Structural Stage by Tree Species and Suitability for Alternative 3, Pre Spruce Beetle Epidemic (FS Veg).

Tree Species	Suitability	Habitat Structural Stage							Acres by tree species
		2T	3A	3B	3C	4A	4B	4C	
Aspen (mixed with other non-spruce types)	Suitable	1,648	3,918	15,243	8,838	3,567	24,049	13,373	70,636
	Unsuitable	394	8,760	18,448	12,699	4,691	23,037	18,390	86,419
Aspen/Spruce Mix	Suitable	126	1,368	6,437	2,717	529	9,519	17,505	38,201
	Unsuitable	95	1,507	8,176	1,785	1,508	8,145	10,724	31,940
Spruce /Spruce Mix	Suitable	92	1,739	3,955	1,294	1,671	13,057	13,056	34,864
	Unsuitable	27	1,212	2,413	1,776	4,534	10,486	13,833	34,281
Sub Total Acres	Suitable	1,866	7,025	25,635	12,849	5,767	46,625	43,934	143,701

Tree Species	Suitability	Habitat Structural Stage							Acres by tree species
		2T	3A	3B	3C	4A	4B	4C	
	Unsuitable	516	11,479	29,037	16,260	10,733	41,668	42,996	152,640
Total Acres		**2,381**	**18,505**	**54,672**	**29,109**	**16,501**	**88,294**	**86,930**	**296,391**

The distribution of size and density is skewed toward larger trees with higher amounts of canopy cover across all vegetation types, meaning that most of the stands on the GMUG are comprised of older trees, which are generally larger. Large acreages of vegetation in this condition is at risk to loss, as disturbance events, including insects, disease and effects of climate occur.

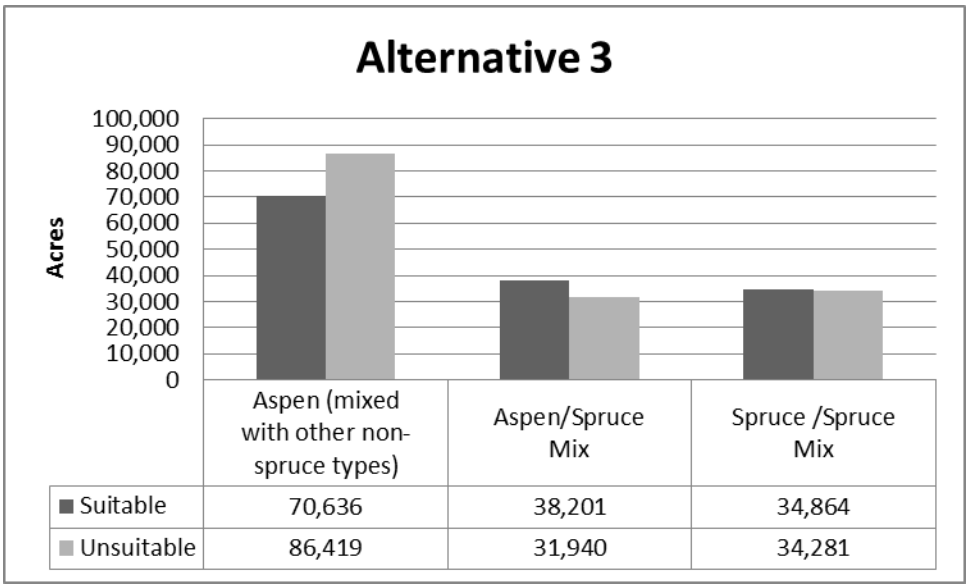
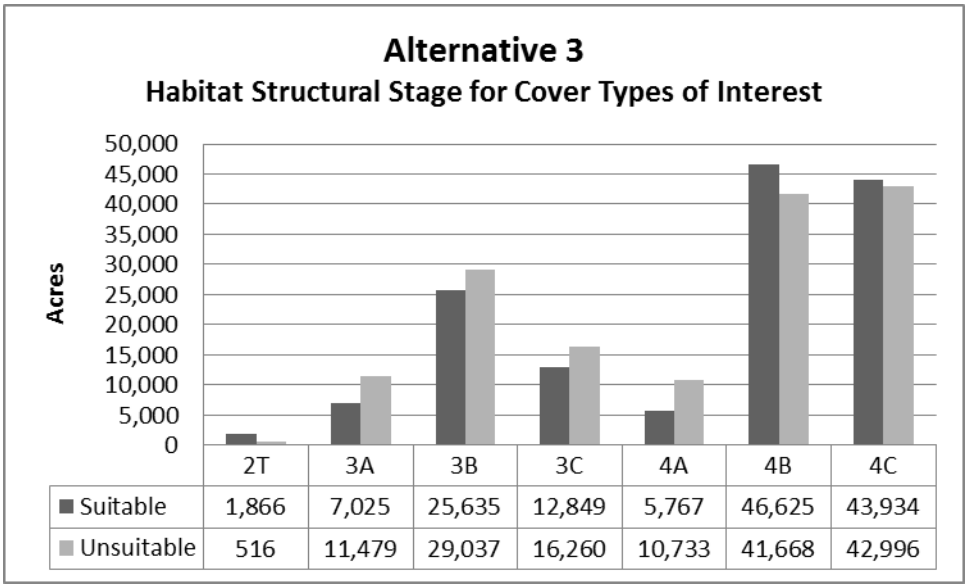


Figure 38. Existing condition pre-spruce beetle epidemic with Alternative 3 suitable and unsuitable acres.

There is a significantly smaller amount of acres identified in the opportunity areas for treatment that are suitable than under Alternative 2 or Alternative 4.



	2T	3A	3B	3C	4A	4B	4C
Suitable	1,866	7,025	25,635	12,849	5,767	46,625	43,934
Unsuitable	516	11,479	29,037	16,260	10,733	41,668	42,996

Figure 39. Alternative 3. Existing condition pre-spruce beetle epidemic: Habitat structural stage and suitability.

The total Alternative 3 opportunity area covers 426,000 acres in the WUI. Opportunities for commercial treatments would be limited to the 164,000 acres of suitable timber in the WUI.

Treatment focused in the WUI would likely lead to a greater number of acres with WUI treated. If planning efforts remain focused primarily in the WUI, then available funding and other resources would remain in this focus area.

Stands outside of the WUI would remain at high densities, which would not effectively reduce the risk of future beetle outbreaks. Age class diversity in aspen would not exist outside of the WUI, which would not effectively address potential future climate scenarios and the need to create age class diversity on a landscape scale.

The direct effects to the stands that are treated under this alternative in regards to resilience, resiliency/recovery, and recovery are the same as under alternative two. The primary difference is the direct effects would be only related to the WUI and not contribute to the desired conditions at the landscape scale. Within this alternative there are approximately 40,000 acres that have been mapped as areas where species conversion could occur if recovery treatments are identified.

The effects of Alternative 3 to the overall landscape would mean a decrease of treatments in areas outside of the WUI, and an increase in treatments inside of the WUI. This would lead to a decrease of landscape level treatment. Stands that have been heavily impacted by spruce beetle

and aspen decline would not be reviewed for treatment if they were outside of the WUI. This would then not assure any type of recovery or resiliency treatments, which may lead to and perpetuate the current spruce beetle outbreak, as stands would remain at high density which would leave them more susceptible to current and future outbreaks. SAD affected stands outside of the WUI would not receive treatment, which would not enable suckering to readily occur in untreated stands.

Under this alternative, treatments would be solely focused in the WUI. This may result in a greater number of acres being treated in the WUI, rather than being distributed across the larger landscape. The volume of harvest may also be reduced under this alternative, as the focus may shift to areas that do not have as much economic value, or may be expensive to treat. The treated areas would have similar effects as reported under Alternative 2. The untreated area effects would be similar to those reported under effects section of the 'no action' alternative.

Alternative 4 (Spruce Salvage) – Direct and Indirect Effects

Treatments would occur in the same geographic areas as Alternative 2, except commercial mechanical treatments would also occur in areas outside the 24 focus LAU's on suitable timber lands in aspen, spruce or aspen/spruce mix, resulting in an additional 55,000 acres available for commercial treatment opportunities relative to Alternative 2. The total opportunity area encompasses 718,000 acres. Opportunities for commercial treatments would be limited to the 323,000 acres of suitable timber.

Alternative 4 has the largest opportunity area for commercial treatments, but does not propose to treat a greater number of acres. There are more places to potentially treat under this alternative but the overall acres treated would not be increased.

Table 65. Habitat Structural Stage by Tree Species and Suitability, Pre Spruce Beetle Epidemic for Alternative 4 (FS Veg).

Tree Species	Suitability	Habitat Structural Stage							Acres by tree species
		2T	3A	3B	3C	4A	4B	4C	
Aspen (mixed with other non-spruce types)	Suitable	2,418	6,072	24,486	15,617	6,521	40,750	20,323	116,187
	Unsuitable	501	14,635	31,371	20,114	7,994	37,821	26,548	138,984
Aspen/Spruce Mix	Suitable	252	3,611	17,334	4,718	2,190	29,010	34,602	91,717
	Unsuitable	95	3,919	18,979	3,823	4,110	21,069	11,706	63,701
Spruce /Spruce Mix	Suitable	164	5,914	21,045	6,083	6,902	42,623	35,947	118,678
	Unsuitable	28	4,683	12,835	7,259	13,203	39,278	47,869	125,155

Tree Species	Suitability	Habitat Structural Stage							Acres by tree species
		2T	3A	3B	3C	4A	4B	4C	
Sub-Total Acres	Suitable	2,835	15,597	62,685	26,418	15,614	112,383	90,873	326,405
	Unsuitable	656	23,237	63,185	31,196	25,307	98,167	96,123	337,871
Total Acres		**3,520**	**38,834**	**126,050**	**57,615**	**40,920**	**210,551**	**186,995**	664,485

The distribution of size and density is skewed toward larger trees with higher amounts of canopy cover across all vegetation types, meaning that most of the stands on the GMUG are comprised of older trees, which are generally larger. Large acreages of vegetation in this condition is at risk to loss, as disturbance events, including insects, disease and effects of climate occur.

The direct effects of aspen treatments can be reviewed under Alternative 2, since they will not be different.

In Alternative 4, only spruce stands that have been affected by spruce bark beetle would be treated to meet recovery objectives and to increase the resilience of neighboring green stands (via sanitation harvest). No green-stand treatments would occur to create multi-storied stand conditions in spruce. All other treatment types, methods and target acres would remain the same as described in Alternative 2.

The lack of resiliency treatments in spruce stands means that this alternative would not meet the intent of the Western Bark Beetle Strategy. Because stands that are not currently affected would receive no treatment, it would effectively leave all of the unaffected stands vulnerable to continued and future outbreaks of spruce beetles. Within this alternative there are approximately 72,000 acres that have been mapped as areas where species conversion could occur if recovery treatments are identified.

Salvage only of dead trees would result in high levels of efficiency during implementation as there would be no need to consider how to treat stands that are not affected. This may increase the efficiency of project implementation from the standpoint that all the treatments pursued would be identical. The dead trees would be harvested from an area and then work would move to another place. This may assist in capturing the value of the recently killed trees. However, as time moves forward and the project lifespan increases, the trees that would be available for harvest under this alternative may have very little economic value.

The 1991 Forest Plan specifically authorizes treating over 40 acres in the event of a catastrophic event. Page III-42 of the Forest Plan states “The minimum size of opening created by the

application of even-aged silviculture will be 40 acres regardless of forest cover type. Exceptions are: (b) larger openings are the result of natural catastrophic conditions of fire, insect or disease attack."

Openings larger than 40 acres could be created under Alternative 4. Alternative 4 has the potential to treat the greatest number of acres for salvage logging, which could effectively allow for the greatest number of contiguous acres to be in the stand initiation phase. A new age cohort would develop across more contiguous acres, which over the next 20 to 30 years would increase the amount of early and mid-seral successional stages across the landscape.

Cumulative Effects Common to All Action Alternatives

As under the cumulative effects analysis for the No Action, impacts of past activities on silviculture are reflected in the baseline.

Current and future vegetation management activities authorized by other decisions are noted in the table below.

Agency	District	Foreseeable Future Project	Impacts within the range of those described in direct and indirect impact (Yes/No) and effects analysis and additional comments.
USDA Forest Service	Gunnison	Cochetopa Hills Vegetation management	Yes
	Grand Valley	Mesa Point Fuels treatments	Yes
	Norwood	Naturita Fuels	Yes
	Grand Valley	Spruce Beetle SAD treatments	Yes
	Grand Valley	Resort Mesa treatments	Yes
	Ouray	Escalante Forest Restoration treatments	Yes
	Gunnison	La Garita salvage treatments	Yes
USDI BLM	Gunnison Field Office	Gunnison Spruce Beetle Response	Yes

SBEADMR, in combination with reasonably foreseeable management actions, would facilitate regeneration of spruce-fir and aspen and increase age-class diversity in treated stands.

As noted in the cumulative effects analysis for the No Action, climate change is increasingly accepted as a primary driver of forest cover change in this region (Funk et al 2014; Worrall et all 2010; Worrall et al 2008). Proactive strategies such as SBEADMR, designed to anticipate and respond to the impacts of climate change, may increase the capacity of ecosystems to survive (Scholes et al. 2014). Because SBEADMR includes management strategies outlined in Rehfeldt et al. 2015, managers can focus treatments where they are predicted to be most effective over the long-term. Recovery and resiliency treatments would be focused on late seral successional stages and tend to balance the landscape across all successional stages by managing the stands through the stand initiation stage into stem exclusion. Specifically, recovery treatments would allow stand re-initiation which would indirectly increase the amount early and mid-seral successional stages over the next 20 to 30 years.

Wildlife (Terrestrial)

This section presents the analysis and determination of effects of the proposed action on federally listed wildlife species (endangered, threatened, and proposed) as well as Regional Forester-designated sensitive species (FSM 2670.3) and critical habitat. Potential effects on Forest Service sensitive species and Management Indicator Species are also evaluated.

Following a general discussion of the affected environment, more specific information regarding wildlife species and associated analyses is included in the following order:

- Threatened, Endangered, and Proposed Species
- Sensitive Species
- Management Indicator Species (MIS)

Compliance with Regulatory Direction

Federal Laws and Regulations

Federal laws guiding this project include the Endangered Species Act (ESA) (19 U.S.C. 1536 (c), 50 CFR 402.12 (f) and 402.14). Section 7(a) (1) of the ESA requires federal agencies to use their authorities to further the conservation of listed species. Section 7(a) (2) requires that federal agencies ensure any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of federally-listed species, or destroy or adversely modify designated critical habitat.

Forest Service Policy and Direction

The project is guided by the 1991 Grand Mesa, Uncompahgre and Gunnison National Forests Amended Land and Resource Management Plan (Forest Plan) and the 2008 Southern Rockies Lynx Amendment (SRLA). The Forest Plan includes a list of Management Indicator Species to

be monitored during forest plan implementation "in order to assess the effects of management activities on their populations and the populations of other species with similar habitat needs which they may represent" (FSM 2620.5). The SRLA applies to all eight Forest Plans in the Southern Rockies to better conserve Canada lynx, which is listed as threatened under the Endangered Species Act.

Federally Listed Species

Applicable SRLA Objectives, Standards and Guidelines

The following objectives, standards and guidelines from the SRLA (USDA Forest Service 2008) are applicable to the proposed project:

- **Objective ALL O1:** Maintain or restore lynx habitat connectivity in and between Lynx Analysis Units (LAUs), and in linkage areas.
- **Objective VEG O1:** Manage vegetation to mimic or approximate natural succession and disturbance processes while maintaining habitat components necessary for the conservation of lynx.
- **Objective VEG O2:** Provide a mosaic of habitat conditions through time that support dense horizontal cover, and high densities of snowshoe hare. Provide winter snowshoe hare habitat in both the stand initiation structural stage and in mature, multi-story conifer vegetation.
- **Objective VEG O4:** Focus vegetation management in areas that have potential to improve winter snowshoe hare habitat but presently have poorly developed understories that lack dense horizontal cover.
- **Standard VEG S1:** If more than 30% of the lynx habitat in an LAU is currently in a stand initiation structural stage that does not yet provide winter snowshoe hare habitat, no additional habitat may be regenerated by vegetation management projects.
- **Standard VEG S2:** Timber management projects shall not regenerate more than 15% of lynx habitat on NFS lands within an LAU in a ten-year period. Salvage harvest within stands killed by insect epidemics does not add to the 15%, unless the harvest treatment changes the habitat to unsuitable.
- **Standard VEG S6:** Vegetation management projects that reduce winter snowshoe hare habitats in multi-story mature or late successional conifer forests may occur only/Exception 3 applies – For incidental removal during salvage harvest (e.g. removal due to location of skid trails) or Exception 4 – Where single tree and small group selection practices are employed to maintain and encourage multi-story attributes as part of gap dynamics.
- **Guideline VEG G1:** Vegetation management projects should be planned to recruit a high density of conifers, hardwoods, and shrubs where such habitat is scarce or not available. Priority for treatment should be given to stem-exclusion, closed-canopy structural stage

stands to enhance habitat conditions for lynx or their prey (e.g. mesic, monotypic lodgepole stands). Winter snowshoe hare habitat should be near denning habitat.

- **Guideline VEG G5:** Habitat for alternate prey species, primarily red squirrel, should be provided in each LAU.
- **Guideline VEG G11:** Denning habitat should be distributed in each LAU in the form of pockets of large amounts of large woody debris, either down logs or root wads, or large piles of small wind thrown trees ("jack-strawed" piles). If denning habitat appears to be lacking in the LAU, then projects should be designed to retain some course woody debris, piles, or residual trees to provide denning habitat in the future.

Management Direction for Canada Lynx

Table 66 displays management goals, standards and status of forest-wide and Lynx Analysis Unit (LAU) vegetation management caps the GMUG is required to track under the SRLA Forest Plan amendment.

Table 66. Management Direction and Standards and Associated Habitat Impact Caps Under VEG S1, S5 and S6, SRLA (USDA Forest Service, 2008).

Management Goals	Management Objectives	Standard - Forest-wide or LAU acre limitation (2008)	Standard - Forest-wide or LAU acres remaining as of 2015	Comments
All Management Practices and Activities - Objective O1: Maintain or restore lynx habitat connectivity in and between LAUs and in linkage areas.	All S1 Standard– New or expanded permanent developments and vegetation management projects must maintain habitat connectivity in an LAU and/or linkage area.	None	None	Attainment occurs at the project-level through project layout and implementation of Design Features.
Vegetation Management Practices – Objective VEG 01 – Manage vegetation to mimic or approximate natural succession and disturbance processes while maintaining habitat components necessary for conservation of lynx. Objective VEG 02 – Provide for a mosaic of habitat conditions through time to support dense horizontal cover, and high densities of snowshoe	VEG S5 Standard – Precommercial thinning practices and similar activities intended to reduce seedling/sapling density are subject to within 200 feet of administrative sites, dwellings, or out-buidings or conifer removal in aspen where aspen is in decline.	Precommercial thinning cannot exceed 1% of the lynx habitat in any LAU over the life of the Amendment. .	Tracked at the LAU level.	
		Exemption- Precommercial thinning in WUI is limited to 3% of the total lynx habitat on the Forest. **Total acres available = 42,293**	**42,162**	A total of **131** acres of WUI treatment has been completed or 0.3% of the total CAP.

Management Goals	Management Objectives	Standard - Forest-wide or LAU acre limitation (2008)	Standard - Forest-wide or LAU acres remaining as of 2015	Comments
hare. Provide winter snowshoe habitat in both the stand initiation structural stage and in mature, multi-story conifer vegetation. Objective VEG 03 – Conduct fire use activities to restore ecological processes and maintain or improve lynx habitat. Objective VEG 04 – Focus vegetation management in areas that have potential to improve winter snowshoe hare habitat but presently have poorly developed understories that lack dense horizontal cover.		Exceptions 1-4 (VEG S5) and exceptions 1-3 (VEG S6) allow combined treatment up to 0.5% of the lynx habitat on the Forest. **Total acres available = 7,071 acres**.	**4,149**	A total of **2,922** acres under exception 1-4 in VEG S5 and Exception 1-3 in VEG S6 is affected or 30% of the CAP.
	VEG S6 Standard – Vegetation and management projects that reduce winter snowshoe hare habitat in multi-story mature or late successional conifer forests may occur only: • Within 200 feet of administrative sites, dwellings, outbuildings, recreation sites and special uses improvements and within ski area boundaries. • For incidental removal during salvage harvest (e.g. removal due to location of skid trails, impacts from logging equipment). • Where uneven-aged management practices are employed to maintain or encourage multi-story attributes as part of gap dynamics.	Exceptions 1-4 (VEG S5) and exceptions 1-3 (VEG S6) allow combined treatment up to 0.5% of the lynx habitat on the Forest. **Total acres available = 7,071 acres.**	**4,149**	A total of **2,922** acres under exception 1-4 in VEG S5 and Exception 1-3 in VEG S6 is affected or 30% of the CAP.

Table 67 is a summary of specific management direction based on Vegetation Standards S1, S5 and S6 as described in the SRLA.

Table 67. Management Direction and Guidelines under VEG S1, S5 and S6 (USDA Forest Service, 2008).

Management Objectives	Guidelines
All Management Practices and Activities - Objective O1: Maintain or restore lynx habitat connectivity in and between LAUs and in linkage areas.	New permanent roads should not be built on ridge tops and saddles, or in areas identified as important for lynx connectivity. New permanent roads and trails should be situated away from forested stringers.
Vegetation Management Practices – Objective VEG 01 – Manage vegetation to mimic or approximate natural succession and disturbance processes while maintaining habitat components necessary for conservation of lynx. Objective VEG 02 – Provide for a mosaic of habitat conditions through time to support dense horizontal cover, and high densities of snowshoe hare. Provide winter snowshoe habitat in both the stand initiation structural stage and in mature, multi-story conifer vegetation. Objective VEG 03 – Conduct fire use activities to restore ecological processes and maintain or improve lynx habitat. Objective VEG 04 – Focus vegetation management in areas that have potential to improve winter snowshoe hare habitat but presently have poorly developed understories that lack dense horizontal cover.	VEG G1 – Vegetation management projects should be planned to recruit a high density of conifers, hardwoods, and shrubs where such habitat is scare or not available. VEG G4 – Prescribed fire activities should not create permanent travel routes that facilitate snow compaction. Construction of permanent fire breaks on ridgetops and saddles should be avoided. VEG G5 – Habitat for alternative prey species, primarily red squirrel, should be provided in each LAU. VEG G11 – Denning habitat should be distributed in each LAU in the form of pockets of large amounts of down woody debris, whether down logs or root wads or large piles of small wind throw trees (jack-strawed piles).

Analysis Methodology - All Species

The following analysis is based on professional knowledge, the best available science, and existing occurrence data for each species. For analysis purposes, the greatest extent of opportunity acres for each action alternative are presented. Effects are analyzed based on habitat availability, known occurrences, species life histories and expected responses by species based on changes to habitat. The analysis is primarily qualitative rather than quantitative.

Analysis of the SBEADMR project to Canada lynx and their habitat is based on the framework and incidental take statement established by SRLA and supporting documents (USDA Forest Service 2008) and the Biological Opinion (BO) issued by Fish and Wildlife Service (USDI Fish and Wildlife Service, 2008). Most of the impacts associated with the SBEADMR project were addressed by these documents and therefore is included by reference. Analysis completed under SBEADMR builds on this analysis by examining potential effects of completing the maximum amount of treatment (60,000 acres commercial mechanical and 30,000 to 60,000 acres of non-commercial or prescribed burning) primarily at the Lynx Analysis Unit (LAU) scale. The

analysis also assesses the use of the silvicultural prescription matrix, design features and LAU and Forest sale caps to minimize impacts to lynx and to ensure SBEADMR stays within the original incidental take statement issued by Fish and Wildlife Service in 2008. Tracking and reporting to FWS will be conducted annually to ensure cumulative impacts and SRLA management objectives are in-line with Forest Plan and BO requirements.

Potential adverse impacts to other wildlife species (Forest Service sensitive and Management Indicator Species) were completed by comparing treatment outcomes based upon the vegetative indicators within the silvicultural prescription matrix and the use of design features to minimize impacts or achieve a desired outcome. Methods (mechanical or burning) and resulting post-treatment vegetative conditions were compared to the biological needs of affected species. Through the analysis process, recommendations to further minimize effects were made to refine treatment methods or design features as needed.

Affected Environment

The existing condition in the action area has been affected by past and ongoing activities and natural processes, including forestry activities such as timber harvests, grazing, various recreational activities, wildlife use, and wildfire and associated suppression activities. Forested stands have been affected by bark beetle infestation resulting in tree mortality that can be seen across the landscape.

The SBEADMR project will primarily treat Engelmann spruce-subalpine fir (*Picea engelmannii-Abies bifolia*) and aspen (*Populus tremuloides*) vegetation types. Both spruce-fir and aspen occur as or within a matrix of other vegetation types. Most spruce-fir stands in the project area range from 100 to 200+ year old and aspen range from 80 to 120 years old. Spruce-fir stands provide high quality denning, foraging and dispersal habitat for Canada lynx. Other species that utilize spruce-fir are boreal owls, olive-sided flycatchers and sometimes northern goshawks, and mammal species such as the American marten and pygmy shrews. Treatments in the planning area include opportunities to promote/maintain multi-storied, mature stand structures for denning and dispersal habitat that exist within the spruce-fir in the project area.

The aspen species considered in this document generally occur in rare or unusual habitats within the montane and subalpine zones. Some of the aspen stands are those in which conifers are unlikely to succeed them. These stands are mature and are near the end of the physiological life span. Due to heavy browse pressure on aspen sprouts by wildlife species, the successful establishment of a new aspen stand is reduced. Aspen stands provide habitat for a variety of mammal and birds species including deer, elk, small mammals (e.g. chipmunks, gophers, squirrels and voles), northern flicker, black-capped chickadee, house wren, warbling vireo, yellow-rumped warbler and dark eyed junco.

The current vegetation composition of forest stands in the analysis area comprises multiple habitat types:

1) ***Spruce-fir*** - This habitat type contains a rich diversity of bird species with habitat generalists being common, and specialists more adapted to mature spruce-fir forests, including brown creeper, ruby crowned kinglet, white-crowned sparrow, and American three toed woodpecker also common. Spruce-fir also provides habitat for a wide variety of mammals including: Canada lynx, snowshoe hare, red squirrel, boreal owls, American (pine) marten, red-backed voles, black bear, bobcat, red fox, mountain lion, mule deer, elk, and moose.
2) ***Aspen; Aspen/Spruce-fir; mixed conifer; lodgepole pine*** - These habitat types contain a high diversity of bird species including aspen dependent species such as warbling Vireo, yellow-rumped warbler, and house wren, primary cavity nesters including hairy woodpecker, three-toed woodpecker, northern flicker, downy woodpecker and red-naped sapsucker, and generalist species such as the American robin and dark-eyed junco.

Threatened, Endangered, and Proposed Species and Designated Critical Habitat

The following list (Table 68) includes threatened, endangered, and proposed species, and/or designated critical habitat that are located on the GMUG National Forest, or are located adjacent to or downstream from the project and could potentially be affected. Sources of information included the U.S. Fish and Wildlife Service's Environmental Conservation Online System (IPaC) (U.S. Fish and Wildlife Service, n.d.) Forest Service records and files, the State Natural Heritage Program database, state wildlife agency information, and published research.

Species that are candidates for listing under the ESA are automatically placed on the Region 2 Regional Forester's sensitive species list. The analysis and determination of effects for candidate species are included as part of the biological evaluation for sensitive species.

No further analysis is needed for species that are not known or suspected to occur in the project area, <u>and</u> for which no suitable habitat is present. Table 68 documents the rationale for excluding a species. If suitable but unoccupied habitat is present, then additional survey is needed, or presence can be assumed and potential effects evaluated.

Table 68. Federal Threatened, Endangered or Proposed Species That May Occur in the Action Area.

Common Name	Status	Known/suspected to be present?	Suitable habitat present?	Designated Critical Habitat present or could be affected?	Rationale if not carried forward for analysis
Gunnison sage-grouse	Threatened Designated Critical Habitat	Yes	Yes – critical habitat has been designed on the National	Yes	N/A (Carried forward for analysis.)

Common Name	Status	Known/suspected to be present?	Suitable habitat present?	Designated Critical Habitat present or could be affected?	Rationale if not carried forward for analysis
			Forest		
Mexican spotted owl	Threatened	No	No	No	Pre-field review verified there is suitable habitat on the GMUG NF, but there is no suitable habitat present in spruce-fir and aspen habitats that may be treated.
Southwestern Willow Flycatcher	Endangered	No	No	No	Pre-field review and a site visit verified there is suitable habitat in the SBEADMR project area however the opportunity areas where treatments may occur will not include willow stands.
Yellow-billed cuckoo	Threatened	No	No	No	Pre-field review verified there is suitable habitat in the SBEADMR project area however opportunity areas where treatments may occur will not include open woodland habitat.
Uncompahgre Fritillary butterfly	Endangered	No	No	No	Pre-field review verified there is suitable habitat within the SBEADMR project area however opportunity areas where treatments may occur will not include alpine habitats used by this species.
Black-Footed ferret	Endangered	No	No	No	Pre-field review and field surveys verified there is no suitable habitat in the SBEADMR project area. This species has not been documented in the action area.
Canada Lynx	Threatened	No	Yes	No	*(Analysis included)*

Gunnison Sage-grouse

On November 20, 2014, the U.S. Fish and Wildlife Service (FWS) issued a final rule listing the Gunnison sage-grouse as threatened under the Endangered Species Act (79 FR 69192). The FWS also issued a final rule designating 1,429,551 acres of critical habitat in Delta, Dolores, Gunnison, Hinsdale, Mesa, Montrose, Ouray, Saguache, and San Miguel Counties in Colorado, and in Grand and San Juan Counties in Utah (79 FR 69312). Although the proposed treatment activities do not involve suitable habitat for this species, Gunnison sage-grouse could potentially

be affected because transportation routes to access treatment areas and haul material may cross occupied habitat consisting of National Forest, Bureau of Land Management and private lands.

On GMUG administered lands, there are 156,266 acres of critical habitat. The vast majority of critical habitat is located in the Gunnison Basin (620,616 total acres on federal, state, and private lands). The action alternatives have the potential to affect Gunnison sage-grouse in the Gunnison Basin population area and critical habitat unit. Gunnison sage-grouse habitat in the Gunnison Basin ranges from 7,500 to over 9,500 feet. Precipitation levels range from 7 to 16 inches depending on geographic area and elevation. The majority of sage-grouse habitat within the Gunnison Basin receives less than 12 inches of precipitation a year. Typical sagebrush types include mountain big sagebrush, Wyoming big sagebrush, and black sage. Mountain big sagebrush occurs at higher elevations and at lower elevations containing moist sites, and is the most common big sagebrush species on National Forest lands within Gunnison sage-grouse occupied areas and critical habitat.

Canada Lynx(*Lynx Canadensis*)

The Canada lynx is a threatened species under the Endangered Species Act. The lynx's range in North America closely follows the distribution of boreal forests. Its northern most range is in Alaska and Canada where they inhabit the taiga, a classic boreal forest ecosystem. In the western United States, lynx populations extend south into subalpine forests and in the eastern United States, the population extends into the boreal/hardwood forest ecotone. Geographically, lynx populations in the lower contiguous United States extend south along the North Cascade and Rocky Mountain Ranges, the western Great Lakes Region and in northern Maine. The biology, ecology, habitat requirements, anthropogenic influences on lynx and their habitat, and recommended conservation measures are provided in the Interagency Lynx Biology Team Report (Interagency Team Report 2013), the Southern Rockies Lynx Amendment (USDA Forest Service 2008), and the Southern Rockies Lynx Amendment Biological Assessment (Grode, J. 2008) and Biological Opinion (USDI Fish and Wildlife Service 2008) and are hereby incorporate by reference. Information presented below is a summary of these measures plus other information pertinent to the analysis.

Lynx have been confirmed to be present on the GMUG National Forest by Colorado Parks and Wildlife. From February 4, 1999 through February 1, 2005, 121 individual lynx were located within the GMUG National Forests (Shenk 2005), and Colorado Parks and Wildlife monitoring (Shenk 2009) and population level assessments (Theobald and Shenk 2011) indicate lynx have been documented within the project planning area. In addition, the SRLA identifies all lynx habitat for the National Forests in the Southern Rocky Mountains as occupied.

Risk factors that threaten the continued existence of lynx population as identified by the Canada lynx conservation assessment and strategy (Interagency Lynx Biology Team, 2013) include increased human presence, roads, timber and fire management activities, recreation, livestock grazing, and activities associated with human population growth. All of these activities contribute to direct disturbance to lynx as well as loss of habitat, habitat degradation and habitat fragmentation across the landscape.

Activities that increase snow compaction in lynx habitat could facilitate access by other predators, including mountain lion, bobcat, coyote or red fox, that otherwise would not occur due to the limited ability of these predators to move through un-compacted, deep snow areas. This could result in increased competition with lynx for limited prey.

Another risk factor exacerbated by snow compaction is potential increased predation of lynx by mountain lions or coyotes. Lynx may expend more energy to avoid predators by changing movement patterns. Lynx may also expend energy due to displacement/disturbance from increased human presence and activity in the area, and avoid using what is otherwise suitable habitat. This could result in lynx spending less time foraging, bedding, resting, and devoting time to care of offspring.

Critical Habitat: Critical habitat has not been designated for Canada lynx in the southern Rocky Mountains.

Environmental Baseline Status of Lynx Habitat

The environmental baseline includes past and present impacts of all federal, state, and private actions and other human activities in the action area, the anticipated effects of proposed federal projects in the action area that have already undergone Section 7 consultation, and the impact of state or private actions that are contemporaneous with this consultation (50 CFR 402.02).

A total of approximately 1,505,000 acres of lynx habitat within 51 LAUs occur across the GMUG. Of this, approximately 1,494,000 acres are considered suitable habitat, and approximately 10,900 acres are considered unsuitable. Unsuitable habitat is likely due to past vegetation management activities including prescribed burning, fuels reduction, timber harvest, and natural disturbances (i.e., spruce bark beetles).

Other past and ongoing federal actions that influence the distribution of lynx habitat and the use of it by lynx include cattle allotment permit administration and renewals, existing road, trail, and developed recreation site management (such as ski areas, roads, trails, developed campgrounds, day-use sites, scenic viewpoints, trailheads, and parking lots), and outfitter-guide permit re-issuances. Non-federal actions include ranch lands with livestock grazing and hay meadows, management of state wildlife areas by Colorado Parks and Wildlife, management of other federal

lands by the Bureau of Land Management, private lands that include residences scattered across the GMUG NF and general public use associated with recreation activities. The cumulative effects analysis describes in more detail the non-federal actions within the LAUs.

Lynx Analysis Units

Changes to lynx habitat due to federal and non-federal activities described above are reflected in the LAU Environmental Baseline statistics shown in 69. This table displays the amount of acres delineated within each LAU and the estimated number acres of suitable habitat vs non-suitable habitat that currently exist in each unit. This information is important in determining the current condition of each LAU. This data will also be used as a gauge in determining the magnitude of effects to each LAU based on acreages and as a way to track when acreages reach SRLA thresholds. Table 69 documents the environmental baseline for pre-commercial thinning in the GMUG NF LAUs since 10/28/2008, which is the effective date of the SRLA.

Table 72 shows those LAUs where changes to acres of suitable habitat have been documented and reported under SRLA standards VEG S5 and VEG S6.

Under Alternatives 2 and 4, commercial mechanical harvest would occur only on areas identified as suitable for timber production as defined by the GMUG NF Forest Plan. Since Alternative 3 (public safety) is common to all action alternatives, opportunity acres associated with removal of hazard trees along roads or near infrastructure may occur in most LAUs. However, these treatments would only occur if hazard tree removal is required for protection of public safety. Acres presented in Table 69 represent the maximum opportunity acres considered.

Of the total 1,505,000 acres of lynx habitat in the GMUG, a maximum of approximately 444,000 acres fall within the opportunity areas considered in Alternatives 2 and 4. Approximately 230,000 acres occur on lands suitable for timber production. Approximately the remaining 214,000 acres would be considered opportunities for noncommercial mechanical treatment and/or prescribed burning (See Table 69). Approximately 2/3 of the stands in the maximum opportunity area extent are mapped as multi-storied, and 1/3 as single-storied.

Table 69. Lynx Analysis Units in SBEADMR Project Area.

Lynx Analysis Unit	Total Acres of Lynx Habitat in the LAU	Maximum extent of opportunity acres within lynx habitat	Maximum extent of opportunity acres in lynx habitat and on suitable timber areas.	Maximum extent of opportunity acres outside lynx habitat.
Alpine	33,052	13,588	7,033	11
Amphitheater	26,525	2,620	0	131
Anthracite	21,241	73	0	499
Bald Mountain	33,142	4,847	3,873	636
Beckwith Mountain	53,579	906	0	210
Black Mesa	35,625	19,692	9,847	1,733
Brush Creek	36,939	3,408	343	194
Castle Pass	30,877	3,223	1,736	167
Cathedral	21,669	5,032	2,076	237

Lynx Analysis Unit	Total Acres of Lynx Habitat in the LAU	Maximum extent of opportunity acres within lynx habitat	Maximum extent of opportunity acres in lynx habitat and on suitable timber areas.	Maximum extent of opportunity acres outside lynx habitat.
Cebolla	42,312	9,048	4,922	9
Chalk Mountain	24,954	7,129	3,855	315
Chester	36,009	22,792	9,574	3,798
Chimney Rock	24,601	2,829	100	254
Cochetopa	31,598	21,984	10,004	6,166
Cottonwood Lakes	25,538	18,399	10,268	480
Crater Lake	37,464	14,813	11,579	1,028
Dallas Creek	17,942	4,639	81	121
Fossil Ridge	37,429	265	170	859
Gothic x	30,858	7,262	1,820	459
Green Mountain	24,474	15,659	5,702	345
Grizzly Peak	17,538	2,082	1,659	181
Huntsman Mountain	38,583	1,812	804	1,068
Iron Mountain	24,750	2,406	0	132
Island Lake	19,027	17,996	3,063	568
Kannah Creek	11,836	8,325	5,057	91
Lake City	25,721	1,363	516	257
Little Cone	22,420	8,591	4,866	12
Lone Cone	26,026	21,736	19,419	932
Los Pinos Creek	27,428	22,312	11,494	2,521

Lynx Analysis Unit	Total Acres of Lynx Habitat in the LAU	Maximum extent of opportunity acres within lynx habitat	Maximum extent of opportunity acres in lynx habitat and on suitable timber areas.	Maximum extent of opportunity acres outside lynx habitat.
Matterhorn	26,338	4,234	0	744
Mesa Lakes	17,823	12,293	4,934	431
Mount Gunnison	23,279	638	0	862
Needle-Razor	20,960	3,578	2,037	3,056
Peeler Lakes (Kebler	23,626	3,486	517	6
Pitkin	49,154	10,022	3,503	9,173
Ragged Mountain	11,854	123	55	49
Red Creek	44,435	16,307	9,335	1,610
Rocky Brook	42,000	9,660	6,538	107
Sawtooth Mountain	29,063	10,395	2,514	1,389
Soap Creek	43,661	115	61	777
South Mamm Peak	11,269	0	0	536
Spring Creek	33,290	27,956	22,256	2,408
Stewart Creek	33,334	17,111	13,015	345
The Flat Tops	27,889	4,448	1,554	111
Tincup	38,284	7,379	3,559	841
Traver Mesa NEW	35,974	28,872	24,016	2,620
Turret Ridge	26,922	6,553	1,270	16
Upper Taylor	31,228	4,727	2,673	227
Upper Tomichi	35,632	7,165	945	5,471

Lynx Analysis Unit	Total Acres of Lynx Habitat in the LAU	Maximum extent of opportunity acres within lynx habitat	Maximum extent of opportunity acres in lynx habitat and on suitable timber areas.	Maximum extent of opportunity acres outside lynx habitat.
Whetstone Peak	15,633	3,257	1,371	80
Whitecross Mtn	6,974	375	22	27
TOTALS	**1,505,381**	**443,524**	**230,037**	**54,300**

Budget and workforce constraints limits actual treatment between 70,000 to 120,000 acres (40,000 to 60,000 acres of commercial mechanical harvest and 30,000 to 60,000 acres of non-commercial mechanical and prescribed fire) will be treated over the life of the project. Treatment priorities within the opportunity area will be determined during implementation using guidelines identified in Chapter 2 and through a public involvement process. All species other than Canada lynx are analyzed at the scale of the opportunity area for the SBEADMR project. For Canada lynx, the action area described below will be used to evaluate effects on the species.

The following tables (Table 70, Table 71,

Table 72) provide the environmental baseline for Canada lynx, as required by the SRLA.

Table 70. Environmental Baseline Statistics of Lynx Habitat in SBEADMR Project Area.

LAU	Acres of Suitable Lynx Habitat (%of Total Lynx Habitat)	Unsuitable Lynx Habitat (%of Total Lynx Habitat)	Total Lynx Habitat (%of LAU)	Non Habitat (%of LAU)	Total LAU Acres
Alpine	32,126 (97.2%)	915 (3%)	32,126 (64.6%)	16,657 (33.5%)	49,697
Amphitheater	26,400 (44%)	0 (0%)	26,400 (44%)	33,117 (56%)	59,517
Anthracite	20,742 (59%)	0 (0%)	20,742 (59%)	14,600 (41%)	35,342
Bald Mountain	32,171 (62%)	335 (1%)	32,171 (63%)	19,017 (37%)	51,524
Beckwith Mountain	53,369 (67%)	0 (0%)	53,369 (67%)	26,048 (33%)	79,416
Black Mesa	33,391 (98.5%)	501 (2%)	33,391 (63.7%)	18,446 (35.2%)	52,339
Brush Creek	36,745 (59%)	0 (0%)	36,745 (59%)	25,947 (41%)	62,692
Castle Pass	30,599 (74%)	111 (<1%)	30,599 (74%)	10,720 (26%)	41,430
Cathedral	21,414 (99.9%)	18 (<1%)	21,414 (55.1%)	17,396 (44.8%)	38,829
Cebolla	42,099 (99.5%)	204 (1%)	42,099 (62.2%)	25,391 (37.5%)	67,694
Chalk Mountain	24,639 (100%)	0 (0%)	24,639 (78.5%)	6,764 (21.5%)	31,403
Chester	32,155 (99.8%)	56 (<1%)	32,155 (59.9%)	21,486(40.0%)	53,697
Chimney Rock	24,112 (72%)	235 (1%)	24,112 (72%)	9,019 (18%)	33,365
Cochetopa	25,087 (98.6%)	345 (1%)	25,087 (45.5%)	29,742 (53.9%)	55,174
Cottonwood Lakes	24,994 (99.7%)	63 (<1%)	24,994 (71.3%)	9,978 (28.5%)	35,035
Crater Lake	36,381 (99.8%)	55 (<1%)	36,381 (77.9%)	10,232 (21.9%)	46,668
Dallas Creek	17,456 (63%)	365 (1%)	17,456 (63%)	9,990 (37%)	27,811
Fossil Ridge	36,570 (66%)	0 (0%)	36,570 (66%)	18,681 (34%	55,251
Gothic	30,306 (45%)	93 (<1%)	30,306 (45%)	37,658 (55%)	68,057
Green Mountain	24,113 (99.9%)	17 (0.1%)	24,113 (65.9%)	12,437 (34.0%)	36,567
Grizzly Peak	17,005 (47%)	352 (1%)	17,005 (47%)	18,613 (53%)	35,969

LAU	Acres of Suitable Lynx Habitat (%of Total Lynx Habitat)	Unsuitable Lynx Habitat (%of Total Lynx Habitat)	Total Lynx Habitat (%of LAU)	Non Habitat (%of LAU)	Total LAU Acres
Huntsman Mountain	37,515 (79%)	0 (0%)	37,515 (79%)	10,034 (21%)	47,549
Iron Mountain	24,737 (49%)	0 (0%)	24,737 (49%)	25,838 (51%)	50,576
Island Lake	18,326 (99.3%)	132 (1%)	18,326 (71.4%)	7,190 (28.0%)	25,649
Kannah Creek	11,698 (99.6%)	47 (<1%)	11,698 (48.7%)	12,295 (51.1%)	24,040
Lake City	25,262 (54%)	202 (1%)	25,262 (54%)	21,589 (46%)	47,052
Little Cone	22,124 (98.7%)	284 (1%)	22,124 (71.3%)	8,628 (27.8%)	31,036
Lone Cone	24,476 (97.5%)	618 (3%)	24,476 (70.6%)	9,563 (27.6%)	34,657
Los Pinos Creek	24,265 (97.4%)	642 (3%)	24,265 (68.1%)	10,710 (30.1%)	35,617
Matterhorn	25,595 (57%)	0 (0%)	25,595 (57%)	19,692 (43%)	45,287
Mesa Lakes	17,113 (98.4%)	279 (2%)	17,113 (73.7%)	5,826 (25.1%)	23,217
Mount Gunnison	22,417 (59%)	0 (0%)	22,417 (59%)	15,813 (41%)	38,230
Needle-Razor	17,822 (99.5%)	82 (1%)	17,822 (36.7%)	30,632 (63.1%)	48,536
Peeler Lakes (Kebler	23,620 (73%)	0 (0%)	23,620 (73%)	8,780 (27%)	32,400
Pitkin	38,850 (48%)	1,131 (1%)	38,850 (48%)	41,061 (52%)	81,042
Ragged Mountain	11,805 (58%)	0 (0%)	11,805 (58%)	8,374 (62%)	20,179
Red Creek	41,929 (97.9%)	896 (2%)	41,929 (72.4%)	14,870 (25.8%)	57,695
Rocky Brook	41,833 (66%)	60 (<1%)	41,833 (66%)	21,334 (34%)	63,228
Sawtooth Mountain	27,668 (99.97%)	7 (<1%)	27,668 (66.1%)	14,213 (33.9%)	41,887
Soap Creek	42,711 (66%)	172 (<1%)	42,711 (66%)	21,554 (34%)	64,437
South Mamm Peak	10,733 (50%)	0 (0%)	10,733 (50%)	10,598 (50%)	21,331
Spring Creek	30,524 (98.8%)	359 (1%)	30,525 (85.4%)	4,864(13.6%)	35,747
Stewart Creek	32,179 (97.5%)	810 (3%)	32,179 (56.5%)	24,013 (42.1%)	57,002

LAU	Acres of Suitable Lynx Habitat (%of Total Lynx Habitat)	Unsuitable Lynx Habitat (%of Total Lynx Habitat)	Total Lynx Habitat (%of LAU)	Non Habitat (%of LAU)	Total LAU Acres
The Flat Tops	27,774 (99.99%)	4 (<1%%)	27,774 (64.4%)	15,334 (35.6%)	43,112
Tincup	37,328 (56%)	115 (<1%)	37,328 (56%)	29,148 (44%)	66,591
Travers Mesa NEW	32,945 (98.8%)	408 (1%)	32,947 (84.4%)	5,702 (14.6%)	39,057
Turret Ridge	26,320 (97.8%)	586 (2%)	26,320 (56.8%)	19,417 (41.9%)	46,322
Upper Taylor	30,621 (58%)	380 (1%)	30,621 (58%)	22,197 (42%)	53,198
Upper Tomichi	30,094 (63%)	66 (<1%)	30,094 (63%)	17,758 (37%)	47,919
Whetstone Peak	15,553 (69%)	0(0%)	15,553 (69%)	7,059 (31%)	22,612
Whitecross Mtn	6,947 (58%)	0 (0%)	6,947 (58%)	4,957 (42%)	11,904

Table 71. Environmental Baseline Pre-Commercial Thinning (PCT) Treatments (acres) since October 2008.

Treatment under Exception 5 of VEG S5 (1% of lynx habitat/Forest)[1]	Treatment under Exception 5 of VEG S5 (1% of lynx habitat/LAU)
0	100 (Spring Creek LAU in 2013)

Table 72. Acres of habitat previously affected and accounted for under VEG S5 and S6 of the SRLA.

LAU	Combined Exceptions Under VEG S5 and VEG S6 (Up to 0.5% of Lynx Habitat per Forest)[1]
Cathedral	52
Cebolla Creek	451
Island Lake	2
Kannah Creek	7
Los Pinos	282
Spring Creek	350
Stewart Creek	212
Travers Mesa	782
Cottonwood Lakes, Green Mountain, Island Lake, Kannah Creek, Mesa Lakes, The Flat Tops	784
Total	**2922**

[1]Combination of Exceptions 1-4 under VEG S5 and Exceptions 1-3 under VEG S6.

Lynx Linkage Areas

There are eight Lynx Linkage Areas (LLA) that overlap opportunity areas for the SBEADMR project (Table 73). These LLAs total 223,336 acres and provide habitat connectivity for lynx to move from one forested area to another. Under Alternatives 2 and 4, there are 18,937 acres proposed for treatment within LLAs. Most of the LLAs are composed of suitable habitat with little to no unsuitable habitat within them. As such, they currently provide conditions to allow lynx to travel from one forested area to another. . Linkage areas may consist of forest stringers that connect large forested areas, or mountain passes that connect subalpine forests on opposite sides of a mountain range (Ruediger et al. 2000). Lynx linkage areas are key movement corridors where human activities may also impact lynx dispersal (including highway use, larger areas of vegetation treatments, etc.).

Table 73. Lynx Linkage Areas on the GMUG NF

Name	Total Acres
Battlement Mesa	29,932
McClure Pass	27,034
Cottonwood/Tincup	26,173
Poncha Pass	88,735
North Pass/Cochetopa Hills	33,212
Slumgullion/Spring Creek Pass	7,965
Red Mountain - South Mineral	4,177
Lizard Head Pass	6,108
Total Acres	**223,336**

Roads

Roads in lynx habitat results in the permanent or long-term loss of habitat. It also increases snow compaction due to road use in the winter months. Snow compaction creates conditions that allow predators that cannot travel through deep snow the opportunity to compete for prey with lynx. Motorized recreational use of NFS Roads consists of full-sized vehicles including 4-wheel driving during summer and fall months, dirt bikes, and ATVs. State Highways or Federal Highways are used by full sized vehicles, motorcycles, and some heavy truck traffic with most use occurring during the summer and fall. In the winter months, recreational use of some NFS roads is by snowmobiles. All of these activities result in direct disturbance to lynx due to the noise associated with vehicle use. There is also a risk of collisions between vehicles and lynx if lynx are crossing roads to get from one forested area to another. Snow mobile use compacts snow, creating opportunities for use by predator species to compete with lynx for available prey.

Alternative 1 (No Action) – Direct and Indirect Effects

Gunnison Sage-grouse

Under the No Action alternative, there would be no direct or indirect effects to Gunnison Sage-grouse from SBEADMR. No treatments would occur nor any activities associated with the action alternatives, such as heavy truck traffic. Cumulative effects of past actions are reflected

in the environmental baseline, and reasonable foreseeable management activities in the project area could have a similar effect as the action alternatives –disruption from truck traffic passing through occupied habitat. These effects would be on a smaller scale relative to the effects under the action alternatives.

Lynx

There would be no direct effects to lynx as a result of the no action alternative. No treatments would occur and there would be no risk of displacement or mortality to lynx in the area.

Spruce-fir stands would remain untreated across the GMUG NF. Stands currently impacted by the spruce bark beetle would continue to be affected by this pest and mortality of trees will continue to occur. This will result in an increase in standing dead trees and an increase in dead trees on the ground which will contribute to fuel loads within this vegetation type. Habitat for lynx would be degraded as trees continue to die and may also result in unsuitable habitat if the overstory is greater than 90% dead and little to no regeneration is occurring. In the context of climate change, more frequent and extensive wildfires in high elevation forests are expected irrespective of tree condition (Westerling et al. 2006, Agee 2007, Funk 2012, Rangwala and Rondeau). Increased fire frequency and extent could degrade suitable habitat for lynx, or in the worst case scenario, result in a loss of habitat in the action area for decades.

Under the No Action alternative, stands with little natural regeneration will take longer to re-establish without tree planting. As dead trees fall, the amount of material on the ground will increase, which may slow seedling establishment and block the passage of light and nutrients to seedlings.

There will also be no treatment to aspen stands under the No Action alternative. This would result in an increase in the amount of mortality of individual aspen in stands and will also require aspen stands more time to regenerate under natural conditions. Fuel loads will increase in these stands as more trees die. The increase in fuels could put the stands at risk of a high intensity fire resulting in a stands replacing event.

Alternative 1 (No Action) – Cumulative Effects

Gunnison Sage-grouse

The use of design feature WFRP-14 will minimize/eliminate affects to Gunnison sage grouse and therefore will not add addition cumulative effects to the bird or its habitat.

Lynx

Impacts to lynx from past management actions are reflected in the environmental baseline, above. Impacts from present and reasonably foreseeable management actions in the project area,

such as grazing, recreation use, road use and maintenance, and other planned vegetation management activities would have a continued impact on lynx in the area. These activities would continue to affect vegetation, soil and water quality in the area and may impact prey populations for lynx.

Effects Common to All Action Alternatives

Design features are an integral part of the effects analysis and effects determination and apply to multiple species. Design features were developed in response to the foreseeable adverse impacts as discussed in the effects analysis. Design feature development and emphasis focused on reducing, if not eliminating, impacts (See Table 74 and Appendix B). Design features are common to all action alternatives.

Table 74. Wildlife Design Features.

Threatened, endangered, proposed, sensitive or MIS species	Number	Design Feature	Design Criteria Function in reducing effects
Canada lynx (threatened). Other sensitive species and MIS also benefit, including goshawk, boreal owl, olive-sided flycatcher, pygmy shrew, and American marten.	WFRP-1	All applicable management Objectives, Standards and Guidelines contained in the Southern Rockies Lynx Amendment will be applied during project planning, analysis and implementation.	Contributes to the conservation of lynx on the GMUG NF and fulfills agency requirement under a Biological Opinion issues by Fish and Wildlife Service in 2008. WFRP-10 provides clarity regarding incidental damage to understory trees when implementing salvage or uneven aged management prescriptions. The goal of WFRP-10 is to protect (no-cut areas) larger blocks of high quality advanced regeneration. Un-even aged prescriptions are considered a conservation measure befitting lynx and their prey species, per SRLA, other species benefit by retention of advanced regeneration by providing foraging habitat; maintaining larger wood on the forest floors and cover.
	WFRP-10	Areas supporting live advanced regeneration will be avoided during unit layout. Focus should be placed on areas with >35% Dense Horizontal Cover in blocks greater than 0.3 acres.	

Threatened, endangered, proposed, sensitive or MIS species	Number	Design Feature	Design Criteria Function in reducing effects
	WFRP - 16	To maintain the amount and distribution of lynx foraging habitat over time, manage so that no more than 30% of the lynx habitat in an LAU is in an early stand initiation structural stage or has been silviculturally treated to remove horizontal cover (i.e., does not provide winter snowshoe hare habitat). Emphasize sustaining snowshoe hare habitat in an LAU. If more than 30% of the lynx habitat in an LAU is in early stand initiation structural stage or has been silviculturally treated to remove horizontal cover (e.g., clearcuts, seed tree harvest, pre-commercial thinning, or understory removal), no further increase as a result of vegetation management projects should occur on federal lands. Cumulative impacts include all roads (assessed at 100% impact to the understory) and past management activity affecting the understory (harvest, prescribed fire, thinning, etc.) going back 25 years. A 25% residual impact to the understory due to past vegetation management activities is assumed. As management occurs in the affected LAU over the life of the project, acres affected will be tracked to ensure consistency with this conservation measure.	One of the conservation measures outlined in the August 2013 Conservation Assessment.[18] for Canada lynx is to provide a mosaic that includes dense early-successional coniferous and mixed-coniferous-deciduous stands, along with a component of mature multi-story coniferous stands to produce the desired snowshoe hare density within each LAU. Limiting activities that reduce understory impacts or reset stands of trees to early stand initiation structural stage to 30% at the LAU scale helps ensure a mosaic of habitat conditions across the landscape.
Canada lynx and other species (see WFRP-10)	WFRP-15	Habitat connectivity within harvest units will be maintained through the use of variable retention regeneration harvest methods. Tree retention blocks will cross the width of a large salvage area, but may include natural gaps in vegetation within the blocks. Since the proposed action includes maintaining high quality habitat (>35% DHC) in areas 0.3 acres or larger, these areas could be used as building blocks to maintain connectivity in areas where extensive salvage is proposed. Early-successional tree species will be retained along with shrubs and other vegetation. The blocks would typically be about 150 to 300 feet in length, and as wide as large salvage areas (depending on site conditions [e.g., availability of contiguous effective habitat on both sides of the salvage area, availability of natural connections in the area, fire risk of the fuels condition of the vegetation block, and present condition of the lynx habitat]). The retention blocks would include early-successional stages, or stand initiation that develops after the insect outbreak (such as reinitiation of lodgepole pine, Engelmann spruce and subalpine fir).	WFRP-15 and 9 –reduce impacts to pockets of high quality advanced regeneration less than 0.3 acres and help maintain connectivity for lynx and their prey in the areas affected by harvest.

[18] Interagency Lynx Biology Team. 2013.

Threatened, endangered, proposed, sensitive or MIS species	Number	Design Feature	Design Criteria Function in reducing effects
	WFRP-9	Skid trails and landings will be located to minimize impacts to advanced regeneration. Both landings and skid trails will be designated as part of sale design. Skid trails will be placed at least 100 feet apart, except where they need to tie in together at landings.	
Canada lynx and other wildlife species benefit from screened habitat and large wood on the forest floor.	WFRP-5	Maintain screening cover consisting of live trees, snags, and course woody debris (including jackstraw piles) for lynx and other wildlife on strategically located portions, of the landscape (where feasible) between cutting units, roads, and meadows. This screening cover should be comprised of tree retention strips a minimum of 200 feet wide unless topographic breaks occur between cutting units, roads or meadow openings. This will be especially important within the lynx linkage zones.	Large wood on the forest floor and vegetation strips to provide habitat and cover for lynx and other wildlife species, including MIS, pygmy shrew, olive-sided flycatcher, and boreal toad. Feature also helps maintain connectivity within and between timber stands.
Gunnison sage-grouse (threatened)	WFRP-14	Gunnison sage-grouse – Portions of haul routes may occur in occupied habitat in few areas. Where use of haul routes have the potential to impact Gunnison sage-grouse as determined by the effects analysis, timing restrictions should be applied that prohibit the use of haul routes that occur within 0.6 mi of active leks (breeding sites) from March 15 – May 15.	Eliminates disturbance from vehicular traffic on Gunnison sage-grouse leks during the breeding period between March 15 and May 15.
Cavity nesters, small mammals, raptors.	WFRP-2	At a minimum, in spruce-fir forest types maintain 90 to 225 snags per 100 acres, 10 inches in diameter at breast height (dbh) or greater (where biologically feasible). In aspen forest types, maintain 120 – 180 snags per 100 acres, 8 inches dbh or greater (where biologically feasible). Snags would be maintained away from structures, roads and trails so that they do not create safety hazards to the public. Trees to retain include large live trees with broken or dead tops (snag replacement trees), and other trees showing wildlife signs (dens, nests, cavities, squirrel middens, woodpecker activity) within and adjacent to harvest units to provide for perching, foraging, roosting, and nesting sites for wildlife. To compensate for the lack of snags along road corridors due to removal for OSHA safety needs, leave a greater density of wildlife trees in areas away from roads and landings. Snags within 500 feet of water (creeks, ponds, wet meadows, seeps, and springs), meadows/parks/forest openings, and ridge tops are particularly valuable to wildlife. Where possible, groups of snags in close proximity to each other or associated with green trees will be retained. Retention of snag groups will reduce wind-throw. Where possible, utilize natural sinuosity or drainages for linking groups. Leave snags with a variety of heights, shapes, and decay condition. Generally, taller and larger diameter snags provide better habitat for more species. Leave snags of all species type. Protect standing wildlife trees from damage during site preparation and post-sale activities.	Provides sufficient standing and down wood in areas affected by harvest. Provides for connectivity across the landscape for movement of small mammals and other wildlife species across the landscape. Retention of standing snags also helps maintain habitat for cavity dependent species and perch, roosting and nesting habitats.

Threatened, endangered, proposed, sensitive or MIS species	Number	Design Feature	Design Criteria Function in reducing effects
Lynx, marten, and other species	WFRP-3	Maintain 10-20 tons per acre of coarse woody debris within harvest units to maintain soil moisture at ground level for mosses, fungi, and lichens and to encourage faster re-colonization of harvest units by small mammals and other prey species. Retain some small slash piles to provide habitat for small mammals. Where possible in regeneration units, create piles of logs, stumps, or other woody debris to minimize the effects of larger openings and to provide connectivity to adjacent stands for lynx, marten, and other species that may generally avoid open areas and utilize concentrations of down wood for foraging or denning.	Maintains sufficient large wood on the forest floor for protection of soil resources, creates areas for foraging and denning. Large wood on the forest floor also helps create habitat important for small mammals and micro-sites for establishment of grasses, shrubs and trees. Numerous ground-dwelling species benefit.
	WFRP-4	Maintain large diameter downed logs in various stages of decomposition within harvest units (50 linear feet/acre of 10 inches diameter or larger at the large end of lodgepole pine and aspen logs and/or 12 inches diameter or larger for Engelmann spruce, subalpine fir and Douglas fir logs).	
Northern Goshawk (other sensitive and Management Indicator Species)	WFRP-6	Northern goshawk - No activities will be allowed within ½ mile of active nests from March 1 to August 31 or until fledging has occurred. The timing restriction buffer could be reduced to ¼ mile if topographic features and/or adequate screening cover are present that would protect the nest site from disturbance. No harvest activities will be allowed within a 30-acre buffer of nest sites. Outside of a 30-acre area around goshawk nest sites, timing restrictions are not needed for project layout, marking, and any other activities that are non-disturbing (i.e., activities not involving the use of heavy equipment or chainsaws). Timing restrictions will only apply to active nests, as confirmed by the USFS wildlife biologist.	Minimizes disturbance from heavy equipment and chainsaws to active nests. The 30 acre no harvest zone around nest locations provides cover and forage opportunities. Minimizing human activities around nest sites between March 1 to August 31will reduce disturbance to goshawk when nests are occupied.
Other raptors potentially occurring on the GMUG.	WFRP-7	On-going surveys for raptors would be conducted to determine locations of individuals or populations of these species and allow for the implementation of protection measures using the appropriate buffer or timing restriction, as determined by Colorado Parks and Wildlife raptor guidelines.	Buffer and timing restrictions for other raptor species besides goshawk will be applied as needed to minimize disturbance to nest sites.
MIS and various sensitive species	WFRP-8	Retain all live trees in salvage units, except for trees that need to be removed for operational/safety or silvicultural purposes. Operational/safety or silvicultural purposes include the need to remove live trees if necessary to access dead trees for salvage or to address safety concerns.	Maintains islands of habitat within a harvest unit. Leaving clumps of live and dead trees in the harvest matrix limits blowndown. Helps maintain connectivity of affected stands.

Threatened, endangered, proposed, sensitive or MIS species	Number	Design Feature	Design Criteria Function in reducing effects
Canada lynx, snowshoe hares, minimize soil impacts	WFRP-9	Skid trails and landings will be located to minimize impacts to advanced regeneration. Both landings and skid trails will be designated as part of sale design. Skid trails will be placed at least 100 feet apart, except where they need to tie in together at landings.	Minimizes impact to advanced regeneration and to soils within the harvest unit. Minimizes habitat impacts to hares and small mammals. Benefit to various ground-dwelling species.
Multiple species and long-term site productivity.	WFRP-11	Landings, temporary roads and main skid trails will be evaluated after the completion of operations to determine if detrimental soil compaction has occurred. Based on review by a specialist, when detrimental compaction is found, subsoil ripping will be applied to reduce soil impacts. This would provide for a more suitable seedbed for future regeneration, thus preventing permanent impacts of skid trails that when left in a compacted state, often do not regenerate as well as adjacent un-compacted areas.	Ensure protection of soil resource for long-term productivity of the site. Helps restores vegetative cover.
All TES species	WFRP - 12	Surveys for threatened, endangered, and sensitive (TES) species will occur prior to design of a project. However, since it may take several years to fully implement a project, some level of TES re-survey will occur on an annual basis. If TES species are confirmed present the appropriate standards from the Forest Plan apply.	TES survey data will be used to plan and layout treatment units and transportation system. Re-surveying the project area as needed during implementation will maximize protection of TES species. The district biologist will work with sale administration to implement appropriate standards within the parameters of contract package.
Multiple wildlife species	WFRP-13	Winter logging is encouraged to limit direct disturbance to the fewest number of wildlife species as possible. When possible, avoid treatment activities in areas where big game (elk, pronghorn and moose) are known to occur. When big-game winter range is bisected by proposed haul routes and there are concentrations of animals along these routes minimize stress to wintering animals to the extent practicable by: A. Re-routing along another acceptable route. B. Restrict haul times between 9 am and 4 pm The District Biologist will coordinate with Colorado Parks and Wildlife (CPW) to assess big game use and identify areas where animals concentrate during winter, and assess if there is a need to implement conservation measures. This would be a coordinated effort with GMUG, CPW and the timber purchaser.	Winter is often one of the most stressful times for wildlife. Minimizing disturbance, especially in winter range increases survival rate of adults and reduces probability of aborted fetuses.

Gunnison Sage-grouse

Species

Treatment activities would not occur in occupied areas or suitable Gunnison sage-grouse habitat. However, based on the location of opportunity areas for treatments under all action alternatives, there may be the potential for individual birds in the Gunnison Basin to be disturbed from heavy truck traffic on haul routes that cross occupied areas. During treatment implementation, the District wildlife biologist would determine if access roads and haul routes have the potential to affect Gunnison sage-grouse, especially during the breeding season. If this potential exists, a seasonal timing restriction would be applied to avoid impacts, as described in design feature WFRP 14. The seasonal timing restriction is a complete closure to motorized uses on roads that could disturb lek sites (breeding grounds). WFRP 14 is consistent with current seasonal road closures applied in the Gunnison Basin on County, BLM, and USFS roads in Gunnison sage-grouse habitat to protect birds during the lek season. Therefore, due to these avoidance measures, the action alternatives would have no effect to Gunnison sage-grouse.

Critical Habitat

Treatment activities would not occur in designated critical habitat. Roads used to access treatment areas and as haul routes may go through designated critical habitat on BLM, private, and USFS lands. However, use of roads would be confined to the road prism and wouls not affect any of the critical habitat primary constituent elements (please refer to 79 FR 69312 for primary constituent element descriptions). Therefore, the action alternatives would have no effect to Gunnison sage-grouse designated critical habitat.

Alternative 2 (Proposed Action) Direct and Indirect Effects

Lynx

The Proposed Action will focus on treating stands of spruce-fir affected by bark beetles and aspen stands affected by SAD. Silvicultural treatments will be used to treat stands including salvage harvest and selection of individual and/or groups of trees affected by bark beetles in spruce-fir stands, and coppice cut on aspen stands. Prescribed fire treatment would be used in aspen stands to promote regeneration. Treatments will consist of mechanical and non-mechanical activities. Figure 40 displays opportunity areas under Alternatives 2 and 4. Alternative 2 includes the 24 focus LAU outlined in red as well as public safety areas outside focus LAUs. Under Alternative 2, commercial mechanical harvest will only occur on suitable lands for timber production as defined by the Forest Plan. Alternative 2 also includes areas outside focus LAUs where aspen or spruce-fir may be treated for public safety.

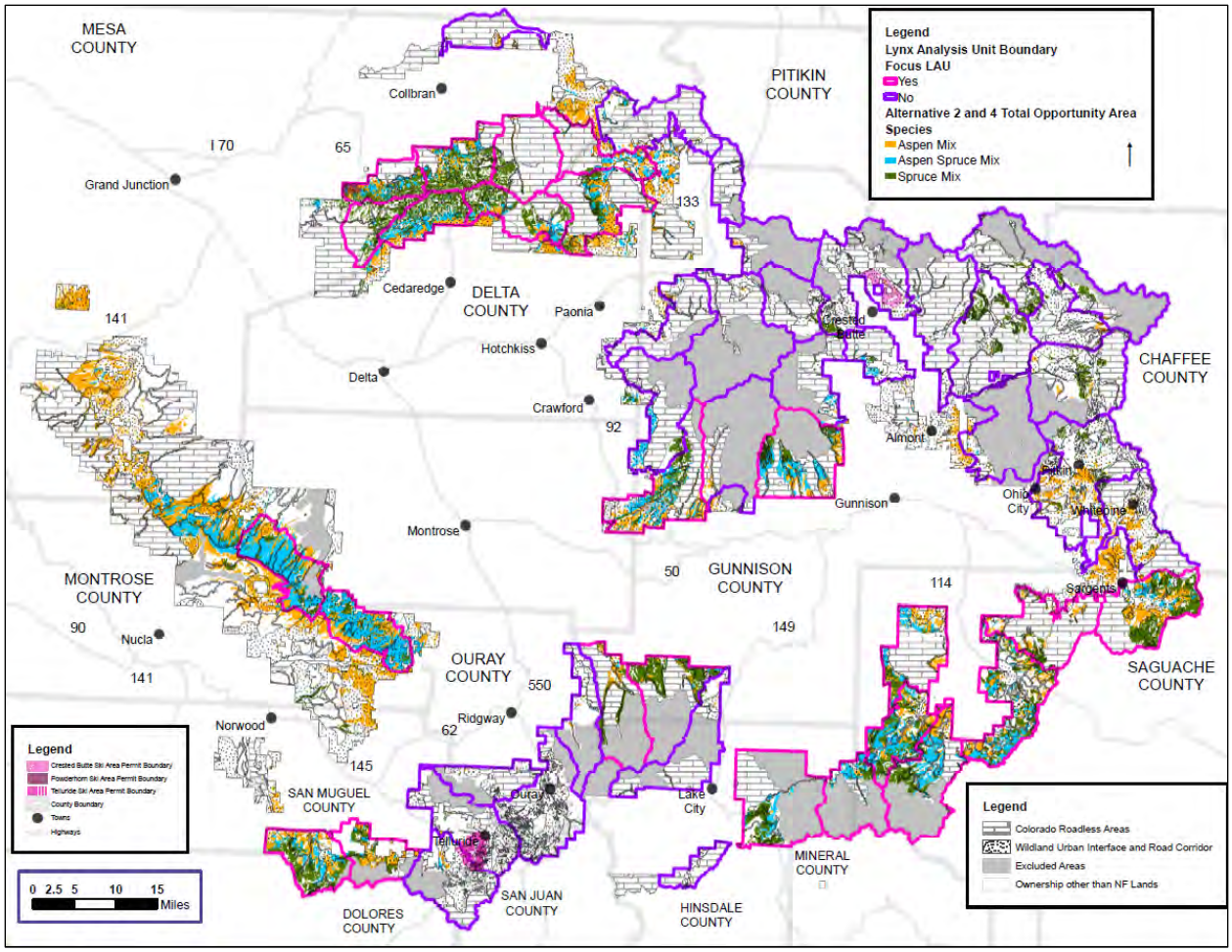


Figure 40. Opportunity acres for Alternatives 2 and 4 in relation to LAU.

In Figure 40, Link Anlysis Units in red are focus LAU under alternative 2. LAU in red and purple contain opportunity arcres under alternative 4 which include all 24 LAU under alternative 2 plus an additional 27 LAU. Direct effect to Canada lynx as a result of implementing SBEADMR's silvicultural prescriptions are discussed in detail in Table 75, below.

<u>Mechanical Treatments</u>: Commercial mechanical treatments in spruce will include single tree or group selection in live spruce stands to salvage of varying degrees in dead spruce using mechanized mechanical harvesters. Mixed stands with spruce and aspen may include a commercial mechanical component or use of equipment to remove understory vegetation to reduce fuels followed by prescribed fire when aspen regeneration is the primary objective. Mastication will not occur in pure spruce-fir stands. Use of heavy equipment to complete treatments will likely result in the temporary displacement of lynx due to noise and increased human presence. Due to the displacement of lynx, it is unlikely treatment activities will result in direct mortality to any individuals.

Increase of traffic associated with project activities may increase the risk of mortality to lynx from vehicular collisions. Traffic count data has been collected on approximately 50 roads on the GMUG over the past 10 years. Vehicles per day range from a few vehicles per day to approximately 550 vehicles per day. Estimated timber volume produced per day is approximately 3,000 ccf or 20 truck loads per day with 2 support pick-up trucks that could use one of the numerous main haul routes leaving the Forest. Project activities may increase logging traffic by an additional 50 vehicles per day. While multiple treatments requiring log trucks may occur across the Forest any given year, road use would be dispersed across the planning area spatially and temporarily. The added vehicle traffic of 50 vehicles per day on a specific route is well-below the 2,000 vehicles per day where increased risk of lynx-vehicle collisions becomes a measureable factor (Clevenger et al. 2002, Alexander et al. 2005). Further, these roads support low volume, low-speed vehicular traffic that is unlikely to result in traffic-related mortality of lynx. Direct mortality from vehicle may increase slightly on major paved highways off Forest but the amount of increased traffic is considered negligible as compared to public vehicle use.

Lynx kittens may be present nearby or in den sites while treatment activities are occurring. Kittens are more vulnerable when they are very young and could potentially be injured or killed by logging equipment and activities. Female lynx will often move kittens to new den sites especially if disturbed and may expend energy moving kittens to avoid disturbances rather than devoting that time to hunting and maternal care of young. However, much of the salvage activity will occur during the summer, fall, and winter months outside of the lynx denning period (April – late June) due to wet soil conditions.

Non-commercial mechanical treatments: Non-commercial mechanical treatments include hand cutting, usually with chain saws, chipping and prescribed fire. Lynx will likely be temporarily displaced by these activities due to the increase in human presence, noise generated by chainsaws and chippers and smoke associated with prescribed fire activities. As described for commercial treatments, there will also be an increase in traffic associated with treatment activities, but it is unlikely to cause any direct collisions with lynx. As described above, both treatment types will likely temporarily displace lynx due to noise and the increased presence of humans. They will likely return to these areas once treatment activities cease. Treatment activities may occur at any time of the year, but will occur in different areas during different periods of time.

Both commercial mechanical and non-commercial mechanical treatments may degrade habitat by reducing cover and tree density as a result of salvage activities and select harvest of trees. Tracked equipment may disturb vegetation in the understory and there would likely be some incidental loss of younger age class trees, such as sapling and pole size trees as equipment moves through stands. Mechanical treatments would result in a temporary loss of habitat due to coppice cuts, road construction and pre-commercial thinning associated with WUI. Pre-commercial

thinning in association with fuels treatments would only occur within 200 feet of structures, per requirements of the SRLA and would be subject to Forest-wide caps associated with VEG S1, VEG S5 and VEG S6. Non-commercial mechanical treatments could temporarily reduce habitat suitability and understory vegetation. Incidental loss of saplings and pole size trees would be minimal as would impacts to soils and shrubby and herbaceous vegetation. Habitat would change in quality, but is not expected to result in a complete loss of habitat.

Of the suitable habitat in LAUs that overlap with opportunity areas, approximately half is considered multi-storied as identified by photo interpretation. Multi-storied stands in lynx habitat are subject to VEG S6 which requires protection of advanced regeneration and minimization of loss of the understory during logging operations. In stands targeted for salvage, design features will be used to avoid advanced regeneration in the understory and direct layout to maintain connectivity in affected stands. Incidental impacts to the understory will be tracked and reported to FWS annually. The amount of affected habitat will also be limited by Forest-wide and LAU based caps as required by the SRLA. Additional limitations have also been added to SBEADMR by limiting total disturbance (roads, past harvest, etc.) to 30% as a conservation measure for lynx (Interagency Lynx Biology Team, 2013).

Resiliency treatments in spruce fir stands are intended to treat those stands where individual or pockets of trees are dead or dying due to bark beetle infestations. Treatments are intended to improve the resiliency of stands by removing dead and dying trees and habitat will remain because stands will still have live healthy trees standing. The goal of these treatments, per SRLA direction, is to maintain and promote multi-story attributes as part of gap dynamics. Resiliency treatments designed to maintain or encourage creation of a multi-story spruce-fir stand are considered a conservation measure under the SRLA. However, some understory trees and shrubs may be affected during logging operations.

Recovery treatments will occur in those stands where the majority of trees have been affected by bark beetle infestations. Salvage of all dead and dying trees in these stands will occur through mechanical means and will be followed up with reforestation activities. Once these areas have been treated, there will be few if any large spruce fir standing but residual pockets of dead and live trees will be retained within harvested units and in matrix areas surrounding harvest units. Where seed sources are lacking, seedlings will be planted. Establishment of young age classes of trees within the LAU will create a mosaic of old and young age classes across the landscape.

Recovery treatments in spruce-fir stands will reduce habitat attributes preferred by lynx, and they will also reduce habitat components for their primary prey species, snowshoe hares. Design features requiring protection of high quality (>35% Dense Horizontal Cover) advanced regeneration will be instituted to minimize impacts. Changes in snag levels, down woody debris, and DHC in areas where treatments occur may degrade habitat conditions for both hares and

lynx. As a result of these changes, lynx may not utilize these areas as habitat until habitat components begin to develop. Wildlife design criteria included in the proposed action includes the retention of snags (90-250/100 acres that are 10”dbh) across the landscape, retaining 10-20 tons/acre of coarse woody debris across treatment areas and maintaining large diameter downed logs of various decomposition stages in treated areas.

Lynx habitat elements will decrease as a result of treatment activities compared to existing conditions, however these design features will help to maintain some habitat components for lynx after project implementation. Other design features that will minimize effects to lynx include maintaining screening cover consisting of live trees, snags, and course woody debris (including jackstraw piles) and the retention of blocks of taller or denser vegetation on strategically located portions of the landscape (where feasible) between cutting units, roads, and meadows for habitat connectivity.

Treatment activities would also result in the incidental loss of understory vegetation and would reduce the quality and quantity of winter foraging habitat for hares. This may affect foraging efficiency for lynx and will also force lynx to expand their foraging areas. DHC that meets the SRLA VEG S6 standard occurs when vegetation cover is at or near snow level generally above 35% and has been found by researchers to provide for quality snowshoe hare habitat during the winter. It not only includes live vegetation, but also includes the stems and branches of dead trees. To minimize effects to DHC, all treatments would:

- Minimize impacts to the extent possible to high quality advanced regeneration and
- Focus on protecting high quality advanced regeneration (>35% DHC) in blocks of 0.3 acres or larger.

The creation of temporary roads would also temporarily reduce the amount of DHC in the action area. Although DHC levels would decrease due to incidental damage from skid trails, landings, and temporary roads, these activities are allowed under Exceptions 3 and 4 of SRLA VEG S6.

Proposed treatments are based on objectives for each mortality level and whether DHC is ≥35% or <35% in the stand. Commercial mechanical and non-commercial mechanical treatments may be used with specific effects to lynx described above.

Aspen resiliency treatments include coppice cuts and prescribed fire. Aspen is not considered a primary habitat for lynx but it is a secondary habitat if it is within 900 feet of spruce-fir stands. When coppice cut treatments occur in these stands, the stand would be affected but not converted to unsuitable habitat. Treated aspen would re-sprout and become established much faster than spruce-fir stands. Table 76 is a summary of effects to secondary lynx habitat based on treatments to aspen stands affected by SAD.

The use of resiliency treatments and recovery (salvage) would assist in the creation of improved conditions for fire and fuels management. Treatments would result in locations across the landscape from which firefighters can safely and effectively manage or suppress fires for values at risk and/or resource benefit. By doing so, it would benefit all species and their habitat by reducing the risk of a stand replacing fire compared to existing conditions because there would be a minimal amount of standing dead trees in treated areas. Another benefit from improved conditions for fire fighter safety and fuels management in WUI will be an increase in the potential use of natural ignitions that can be managed for resource benefit both within spruce-fir and aspen.

Table 75. Potential Effects to Lynx Based on Proposed Silvicutural Prescriptions

Stand Condition	Overstory Mortality Level	Treatment	SRLA Tracking	Effects to Lynx Habitat
Single Storied	<40%	• Individual tree selection. • Removal focused on pockets of dead and dying spruce-fir. • Harvest 15-25% of stand. • May require mechanical site prep.	N/A	Single storied stands are not high quality suitable habitat for lynx. Treatments in these stands will not result in a loss of habitat and are intended to generate a multi-storied stand, increase DHC in the understory by promoting shade tolerant species growth and improve the stand's resiliency to future bark beetle attacks. This will improve habitat for snowshoe hares, the lynx's primary prey. Stands will continue to provide suitable foraging habitat and is expected to improve in quality over time.
	Between 40-90%	• Remove all dead and dying spruce-fir in areas where adequate seed source exists. • Group selection where mortality is patchy. • Clear cut where mortality is extensive. • Create small openings in areas where <40% mortality occurs. • Maximum removal is 40% of present stocking within residual stand to maintain wind "firmness". • May require mechanical site prep.	N/A	Existing habitat is not high quality and treatments will continue to support low quality habitat. Areas where clear cut treatments occur, incidental loss to understory habitat may occurmay occur in advanced regeneration is not avoided. Foraging habitat will continue to exist in areas where DHC is ≥35%. Live, healthy trees will be retained around clear cut areas providing some suitable habitat adjacent to clear cut areas. Pockets of habitat would be protected from removal to the extent practicable during harvest operations. Over time, treatments are intended to improve habitat by generating multi-storied stands, increasing DHC in the understory, and improving the stand's resiliency to bark beetle attacks. Creation of younger age classes through treatment should reduce vulnerability of spruce-fir stands to future mortality from spruce beetles.

Stand Condition	Overstory Mortality Level	Treatment	SRLA Tracking	Effects to Lynx Habitat
	>90%	• Remove all dead and dying spruce-fir where there is no adequate natural seed source. • Clear cut where mortality is extensive. • May require mechanical site prep.	N/A	If >90% is dead or projected to be dead in two years and there is no green understory present, it is considered unsuitable lynx habitat and further salvage logging will not make it "more" unsuitable. Where pockets of advanced regeneration exists, treatments will focus on maintaining advanced regeneration to support lynx foraging habitat in treated areas. Planting of spruce-fir may also occur to restore stands affected by bark beetles. Once DHC in these stands develops, stand may once again provide high quality lynx habitat.
Two Storied	<40% and ≥35% DHC and advanced regeneration above mean snow depth	• Individual tree selection or group selection in 0.25 to 2 acre openings. • Removal focused on pockets of dead and dying spruce-fir.	Veg S1, S2 and S6	High quality habitat will continue to exist for lynx after treatments are implemented. Both denning and foraging habitat will continue to exist post treatment and stands are expected to be more resilient to future bark beetle attacks. This will also result in stands continuing to support lynx habitat and will decrease the chances of habitat loss in the long term.
	<40% and <35%DHC	• Individual tree selection or group selection in 0.25 to 2 acre openings. • Remove dead and dying spruce-fir.	Veg S1 and S2	Suitable habitat exists in these stands and is not considered to support high quality foraging habitat due to low quality DHC. Treatments will retain high quality advanced regeneration where it exists while promoting the growth of understory vegetation to increase DHC. Habitat will continue to support lynx after treatments; however, foraging habitat will continue to be low quality. It is expected foraging habitat may improve over time.
	Between 40-90% and ≥35% DHC and advanced regeneration above mean snow depth	• Salvage of dead and dying. • Follow uneven aged management prescriptions in areas where mortality is lower. • Remove live trees that pose a blow down risk. • Maximum removal is 40% of present stocking within residual stand to maintain wind "firmness".	Uneven aged prescription VEG S1 and S2 Salvage or even aged prescription VEG S1, S2 and	These stands are high quality habitat and treatments will retain as much of that habitat in stands as possible. The removal of dead and dying trees will affect lynx habitat by altering stand structure reducing canopy cover. Understory vegetation will be retained as much as possible which will provide habitat for snowshoe hares. Habitat may be degraded with treatments, but treatments are intended to improve stands in the long term, and improve tree age class diversity and species composition. As a result, stands will

Stand Condition	Overstory Mortality Level	Treatment	SRLA Tracking	Effects to Lynx Habitat
			S6.	continue to support lynx habitat.
	Between 40% and 90% and <35%DHC	• Salvage of dead and dying. • Follow uneven aged management prescriptions in areas where mortality is lower. • Remove live trees that pose a blow down risk. • Maximum removal is 40% of present stocking within residual stand to maintain wind "firmness".	Uneven aged prescription VEG S1 and S2 Salvage or even aged prescription VEG S1, S2.	Suitable habitat exists in these stands however foraging habitat is marginal due to the presence of low DHC. Treatments will retain high quality advanced regeneration where it exists while promoting the growth of understory vegetation. This will improve foraging habitat for lynx and may also maintain pockets of suitable denning habitat post treatment. Habitat may be degraded with treatments, but treatments are intended to improve stands in the long term, and improve tree age class diversity and species composition.
	>90% and ≥35% DHC and advanced regeneration above mean snow depth or >90% and <35%DHC	• Stand no longer two storied due to dead overstory. • Salvage of dead and dying spruce-fir.	Incidental damage to advanced regeneration tracked under VEG S1 and S2	Advanced regeneration will be maintain to the greatest extent practicable. Foraging habitat may exist in these areas after treatments have occurred however denning habitat is unlikely to exist and cover will be limited. Planting may also occur to restore stands. DHC will increase with planting and over time, stands may once again support lynx denning habitat.
Multiple Canopies	<40% ≥35% DHC and advanced regeneration above mean snow depth	• Individual tree selection or group selection in 0.25 to 2 acre openings. • Removal focused on pockets of dead and dying spruce-fir.	Veg S1, S2 and S3.	These stands are high quality habitat and treatments will retain as much of that habitat in stands as possible. The removal of dead and dying trees will affect lynx habitat by altering stand structure, but creation of small openings will mimic natural stand dynamics to create multiple-age classes of trees and increase species diversity. Overall, treatments may have some incidental loss to the understory vegetation but the effects are expected to be short-term.

Stand Condition	Overstory Mortality Level	Treatment	SRLA Tracking	Effects to Lynx Habitat
	<40% and <35%DHC	• Individual tree selection or group selection in 0.25 to 2 acre openings. • Removal focused on pockets of dead and dying spruce-fir.	Veg S1 and S2	Suitable habitat exists in these stands and is not considered to support high quality foraging habitat due to low quality DHC. Treatments will retain high quality advanced regeneration where it exists while promoting the growth of understory vegetation to increase DHC. Habitat may be degraded with treatments, but treatments are intended to improve stands in the long term, and improve tree age class diversity and species composition.
	Between 40 and 90% and ≥35% DHC and advanced regeneration above mean snow depth	• Salvage of dead and dying. • Follow uneven aged management prescriptions in areas where mortality is lower. • Remove live trees that pose a blow down risk. • Maximum removal is 40% of present stocking within residual stand to maintain wind "firmness".	Uneven aged prescription Veg S1 and S2. Salvage or even aged prescription Veg S1, S2 and S6.	These stands support some high quality habitat and treatments will retain as much of that habitat in stands as possible. The removal of dead and dying trees will affect lynx habitat by altering stand structure and reducing the amount of cover available. Understory vegetation will be retained as much as possible to maintain foraging habitat. In areas where more than one story is retained, denning habitat may remain and is dependent on the availability of cover, size of live and downed trees remaining.
	Between 40 and 90% and <35%DHC	• Salvage of dead and dying. • Follow uneven aged management prescriptions in areas where mortality is lower. • Remove live trees that pose a blow down risk. • Maximum removal is 40% of present stocking within residual stand to maintain wind "firmness".	Uneven aged prescription Veg S1 and S2. Salvage or even aged prescription Veg S1 and S2.	Suitable habitat exists in these stands; however, foraging habitat is marginal due to the lack of or low percent of DHC. Treatments will retain high quality advanced regeneration where it exists while promoting the growth of understory vegetation. This will improve habitat for snowshoe hares which will also improve foraging quality for lynx. If two or more stories are retained, suitable habitat will continue to remain post treatment and foraging habitat could improve with treatments.
	>90% ≥35% DHC and advanced regeneration above	• If two canopies still alive, it is a multi-storied stand. • Salvage of dead and dying.	Incidental damage to advanced regeneration tracked under	Pockets of these stands may still be considered habitat if there is advanced regeneration that is ≥35% DHC and the stand remains at least two storied otherwise it is unsuitable. Some residual loss to understory vegetation will occur during treatment but design features will minimize understory loss. Stands will most likely

Stand Condition	Overstory Mortality Level	Treatment	SRLA Tracking	Effects to Lynx Habitat
	mean snow depth or >90% and <35%DHC		VEG S1 and S2	continue to support hares at some level following treatment. Areas where two or more storied stands remain may still be considered suitable habitat. The quality of habitat will depend on the availability of cover, and size of live and downed trees remaining in the stand. Some areas may also be planted to restore stand quality.

Table 76. Summary of Treatment Effects to Secondary Lynx Habitat in Aspen Stands Affected By SAD

Aspen Stand Condition	Treatment		Effects
	High Suckering Potential	Low Suckering Potential	
No SAD or <50% SAD in stands	• Coppice treatments of aspen if tree defect is low to high. • Prescribed burn feasible if there are sufficient fine fuels	No treatment	Aspen stands that are within 900 feet of primary spruce fir stands are considered secondary habitat. Coppice treatments will likely remove habitat unless there is a sufficient amount of DHC in stands to provide suitable foraging habitat for lynx.
>50% SAD in stands.	Treatment- specific prescriptions to be determined based on site conditions.	• Allow continued succession of stand. • Plant site adapted conifer species as an option.	Secondary habitat for lynx is likely low quality because the amount of the stand affected by SAD. Treatments may further degrade habitat unless DHC is retained at or above 35%.
Aspen Overstory with Spruce Fir Understory	• Coppice treatments of aspen if tree defect is low to high. • Prescribed burn to stimulate aspen where appropriate. • Remove fir and aspen to stimulate additional aspen.	• Defer aspen cut and allow stand to succeed as a spruce-fir dominated stand.	Secondary habitat is high quality. In areas with high suckering potential, coppice treatments may result in the loss of habitat unless DHC is retained at or above 35%. Stands will remain secondary lynx habitat if located within 300m of primary habitat.

Aspen Stand Condition	Treatment		Effects
	High Suckering Potential	Low Suckering Potential	
			In stands with low suckering potential, the lack of aspen treatments is intended to allow the spruce-fir to become the dominant species in the stand. Over time, this will likely convert to primary habitat for lynx. No habitat will be lost and stands will continue to support high quality secondary habitat.
Mixed Conifer with Aspen	• Coppice treatments in patches within the entire stand. • Pile burn as needed. • Use prescribed fire as needed to reduce fuels and regenerate aspen.	• Remove spruce-fir and allow stand to succeed as an aspen dominated stand. • Use prescribed fire as needed to reduce fuels and regenerate aspen.	Stand with high suckering potential will continue to provide secondary habitat for lynx. Coppice treatments will remove suitable lynx habitat unless there is ≥ 35% DHC to support foraging habitat. Areas where broadcast burn treatments occur likely reduce DHC levels which may degrade foraging habitat. Stands will remain secondary lynx habitat.
			In stands with low suckering potential, all spruce-fir will be removed to result in an aspen dominated stand. Stands that are secondary lynx habitat will remain secondary habitat. The use of prescribed fire may reduce existing DHC levels and degrade foraging habitat.

Lynx Linkage Area – As discussed previously, the Proposed Action could treat up to 18,937 acres in LLAs. Treatments could include both commercial mechanical and non-commercial mechanical. These activities could impact linkages if they occur, but project design criteria are included to maintain habitat connectivity and to meet the intent of the SRLA (Objective ALL O1). Linkage areas were established to facilitate lynx dispersal and habitat connectivity between and within LAUs, across highways, and between National Forest Units. Design features WFRP-15 and WFRP-16 will be utilized during treatment layout to ensure impacts to the understory are minimized and connectivity is maintained in the affected stand and within the LAU and linkage area.

Roads – Under the proposed action, road miles and density would be temporarily (and in some cases permanently) increased across the SBEADMR project area for a period of up to 10 years. All newly constructed temporary and at least 80% of designed roads would be decommissioned once all post-treatment activities have been completed. Some of the designed roads may be retained if they are needed for out-year treatments or re-alignment of a road deemed to be causing unacceptable impacts. Any permanent road would result in a permanent loss of lynx habitat in LAUs. As the project is implemented, the location of these roads would be determined based on treatment needs and to minimize impacts to the understory.

The maximum potential amount of designed roads estimated to be constructed based on the total treatment capacity of 60,000 acres over ten years is 60 miles for the proposed action. Assuming a 20 foot clearing width, roads constructed in suitable lynx habitat could result in the conversion of up to 145.5 acres across the GMUG NF into unsuitable habitat. Although some of the newly designed roads may be located in lynx habitat, it is unlikely all 60 miles would be located in lynx habitat. The loss of lynx habitat may be permanent if the road is not decommissioned. The proposed action also includes a maximum potential of 260 miles of temporary roads. Some of these roads would result in a temporary loss of lynx habitat if they are newly constructed within suitable habitat, LAUs or LLAs. If designed roads were retained for administrative use over the long-term and added to the GMUG NF road system, these would be included in the total amount of acres to be reported towards use of Exception 3 under VEG S6.

Snow Compaction – Snow compaction may allow coyotes opportunities to compete with lynx for prey species as they are more efficient at moving through these areas than lynx (Bunnell et al. 2006). However, a study in Montana (Kolbe et al. 2007) has shown that this is not necessarily the case, but the possibility still exists.

It is anticipated that snow compaction will occur in association with road use during winter logging activities and known snowmobile play areas. It is assumed routes used for treatment activities in the winter will have an average width of 20 feet of compaction. Snow compaction will also occur within treatment units associated with skid trails and the removal of trees. All

additional snow compaction will be temporary, lasting only through project implementation and it will occur in different areas during different time periods across the GMUG NF.

The suitable habitat acres available for treatment are the maximum number of acres that are available for treatment under the proposed action and are located in multi-storied stands. Treatments in these areas may count towards SRLA restrictions depending on whether the area is currently suitable habitat and the existing condition of habitat components such as the amount of mortality in the overstory and DHC levels within the stand.

Alternative 2 (Proposed Action) – Cumulative Effects

Lynx

Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (50 CFR 1508.7). Under NEPA, cumulative impacts are 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. In contrast, under ESA the estimated effects of future federal activities are not included, because those future federal actions will be subject to their own Section 7 consultation at the appropriate time. This section of the document is intended to fulfill both ESA and NEPA requirements for the ESA listed species. Table 77 displays types of cumulative effects with the estimated reported number of acres based on activity type from 1994-2014 across the GMUG NF. This list is not inclusive and does not include activities on state land.

Table 77. List of Cumulative Effects Acres from 1994-2014 Based on Type

Activity	1994-2000 Acres	2001-2010 Acres	2010-2014 Acres	Total Acres 1994-2014
Vegetation Management (Silvicultural Treatments)	82,381	95,705	20,709	198,795
Vegetation Management (Fire/Fuels)	41,905	52,776	19.447	114,128
Invasive Plant Treatments	544	785	4,188	5,517
Range Improvements[1]	3,336	1,218	257	4,811
Recreation Enhancement	0	0	79	79

For this analysis, the cumulative effects spatial boundary includes all LAUs that have the potential of being impacted by any of the action alternatives. This includes up to 51 LAUs that may be affected to various degrees under Alternatives 2, 3 and 4 (Table 78). Table 78 provides a complete summary of the number of acres that could be treated in LAUs based on SRLA guidelines, conservation recommendation provided in the 2013 updated Conservation

Assessment for Canada lynx (Interagency Lynx Team, 2013), suitable timber, suitable and unsuitable lynx habitat, opportunity areas, roads and previous activities that have been tracked under SRLA guidelines. Acres of past activities are those that removed dense horizontal cover.

To address potential cumulative effects to lynx, management activities and natural disturbances potentially affecting the understory in spruce-fir were summarized from 1994 through 2014. It was assumed that a road is a permanent feature on the landscape and therefore removes 100% of the understory vegetation permanently. Depending upon the type of vegetation management activity (salvage logging, uneven-aged management, thinning, etc.) or natural events (wildfire) understory vegetation will be affected to varying degrees and the rate of recovery following disturbance also is highly variable. For analysis purposes, it is assumed that a timber stand impacted from anthropogenic or natural causes will have on average a 25% residual impact to understory vegetation. The 25% residual impact is a conservative estimate based upon re-growth of spruce to above average snow-depth (point at which spruce tree growth gets above average snow-depth) which takes approximately 25 years when understories are set back to early stand initiation structural stage. These cumulative impact estimates from past activities are calculated per LAU in Table 78.

The 25% estimate of residual impact from past management or natural events should not be confused with SRLA guideance to complete layout of future management actions to minimize impacts at 15-20% incidental loss to the understory from skids trails, landings, hazard tree removal, or trees damaged/killed from other trees being removed (SRLA Implementation Guide, 2009). Further, incidental damage under SRLA is applied to multi-storied (two or more layers) mature conifer stands only and is tracked under the VEG S6 standard. Design features to protect the advanced regeneration to the greatest extent practicable and avoidance of high quality regeneration in blocks of 0.3 acres or larger should be accomplished through layout of skid trails, harvest units, logging during the winter and oversight of sale implementation by a Forest Service Representative.

Future reasonably foreseeable activities in the project are include ongoing grazing, vegetation and fuels management, road and trail management, as noted in the table below. Impacts from these activities are within the range of effects described in the direct and indirect effects analysis.

Present and Future Projects and Activities in the Cumulative Impacts Analysis Area.

Agency	District	Foreseeable Future Project	Impacts within the range of those described in direct and indirect impact (Yes/No) and effects analysis and additional comments.
USDA Forest Service	Forestwide	Ongoing Grazing Activities	
	Ouray	Owl Creek Road Maintance	Yes.
	Grand Valley	Trickle Park Road improvements and maintenance	Yes.
	Forest-wide, multiple locations	Trail Management	Yes, similar to impacts from roads though greatly reduced.
	Forest-wide	Wild herbivore (elk, deer, moose) browsing and grazing	No
	Forest-wide	Increased recreation pressure, mechanized (bicycles)	Yes. Described in affected environment.
	Grand Valley	Mesa Point Fuels treatments	Yes
	Norwood	Naturita Fuels	Yes
	Grand Valley	Spruce Beetle SAD treatments	Yes
	Grand Valley	Resort Mesa treatments	Yes
	Ouray	Escalante Forest Restoration treatments	Yes
	Gunnison	La Garita salvage treatments	Yes
USDI BLM	Gunnison Field Office	Gunnison Spruce Beetle Response	Yes
Colorado Parks and Wildlife	Forest-wide	Increased recreation pressure, non-motorized (pack and foot trails)	Yes. Described in affected environment.
Public	Forest-wide	Increased development, creating new WUI	No.
Power and Fuels Companies	Forest-wide, especially Grand Mesa	Construction and maintenance of power line and pipeline corridors	No.
	Several sites across forest	Increased demand for mine and drill facilities	No.

Under all action alternatives, total impact from past activities (Table 78), SBEADMR treatments, or other management actions that may result in the conversion of lynx habitat from suitable to unsuitable habitat would be capped at 30% of the lynx habitat within a given LAU as required by

design feature WFRP-16. This design feature is based upon a conservation measure identified in the Interagency Lynx Biology Team (2013) which states:

> *To maintain the amount and distribution of lynx foraging habitat over time, manage so that no more than 30% of the lynx habitat in an LAU is in an early stand initiation structural stage or has been silvi-culturally treated to remove horizontal cover (i.e., does not provide winter snowshoe hare habitat). Emphasize sustaining snowshoe hare habitat in an LAU. If more than 30% of the lynx habitat in an LAU is in early stand initiation structural stage or has been silviculturally treated to remove horizontal cover (e.g., clearcuts, seed tree harvest, precommercial thinning, or understory removal), no further increase as a result of vegetation management projects should occur on federal lands.*

The proposed project would cumulatively increase effects on Forest Service land to lynx habitat when reviewed with other projects/activities. Disturbance from treatment activities would be short-term and would be due to the presence of personnel and equipment during project implementation. Vegetation treatments included in the proposed action will alter existing habitat conditions for lynx and in some cases will temporarily reduce the amount of suitable habitat available. The majority of effects to vegetation will last through the life of the project; however, the magnitude of the effects will decrease in time. After treatments are completed, vegetation conditions will slowly improve and the amount of suitable habitat available will also increase in the long term. However, limiting cumulative impact at the LAU scale to 30% would help maintain the amount and distribution of lynx foraging habitat over time. Other design features to protect snowshoe hare habitat would provide additional protection. Activities such as grazing, recreation use, road use and maintenance and the presence of activity on private land in the WUI will have a continued impact on lynx in the area. These activities will continue to affect vegetation, soil and water quality in the area and may impact prey populations for lynx.

In summary, this cumulative effects analysis concludes that in combination with all past, present, and reasonably foreseeable future activities within the LAUs, all standards and guidelines, exemptions and exceptions contained within the SRLA pertaining to habitat thresholds would be met with the implementation of this project. Therefore, potential cumulative effects would not influence the overall effects determination (in reference to the Endangered Species Act).

Table 78. List of Cumulative Acres from 1994-2014 Having the Potential To Affect Understory Vegetation Important to Lynx and their Prey. Data in the table assumes 100% impact to understory vegetation due to permanent roads and 25% average residual impact.

LAU Name	Total Lynx Habitat Acres	Road Acres	Activities Acres	Road (100% Impact)+ Activities (25% impact)= Estimated Impact Acres	30% of Lynx Habitat in the LAU	Maximum acres where understory vegetation impact from future activites may occur (See Design Feature WFRP-16)	Lynx Habitat that overlaps the Opportunity Area in the LAU	Lynx Habitat in Suitable Timber Areas in the LAU
Alpine	33,052	278	4,253	1,342	9,916	8,574	13,588	7,033
Amphitheater	26,525	508	1,044	769	7,958	7,189	2,620	0
Anthracite	21,241	27	0	27	6,372	6,346	73	0
Bald Mountain	33,142	143	1,392	491	9,943	9,452	4,847	3,873
Beckwith Mountain	53,579	138	0	138	16,074	15,935	906	0
Black Mesa	35,625	482	3,727	1,414	10,688	9,274	19,692	9,847
Brush Creek	36,939	354	213	407	11,082	10,674	3,408	343
Castle Pass	30,877	112	315	191	9,263	9,072	3,223	1,736
Cathedral	21,669	89	1,028	346	6,501	6,155	5,032	2,076
Cebolla	42,312	259	1,956	748	12,694	11,946	9,048	4,922
Chalk Mountain	24,954	158	369	250	7,486	7,236	7,129	3,855
Chester	36,009	616	8,349	2,703	10,803	8,100	22,792	9,574
Chimney Rock	24,601	84	0	84	7,380	7,296	2,829	100
Cochetopa	31,598	1,000	6,219	2,555	9,479	6,924	21,984	10,004

LAU Name	Total Lynx Habitat Acres	Road Acres	Activities Acres	Road (100% Impact)+ Activities (25% impact)= Estimated Impact Acres	30% of Lynx Habitat in the LAU	Maximum acres where understory vegetation impact from future activites may occur (See Design Feature WFRP-16)	Lynx Habitat that overlaps the Opportunity Area in the LAU	Lynx Habitat in Suitable Timber Areas in the LAU
Cottonwood Lakes	25,538	398	3,576	1,292	7,661	6,369	18,399	10,268
Crater Lake	37,464	357	1,688	779	11,239	10,460	14,813	11,579
Dallas Creek	17,942	68	0	68	5,383	5,315	4,639	81
Fossil Ridge	37,429	283	4,067	1,300	11,229	9,929	265	170
Gothic	30,858	576	751	764	9,257	8,494	7,262	1,820
Green Mountain	24,474	200	539	335	7,342	7,007	15,659	5,702
Grizzly Peak	17,538	65	329	147	5,261	5,115	2,082	1,659
Huntsman Mountain	38,583	133	1,009	386	11,575	11,189	1,812	804
Iron Mountain	24,750	359	273	427	7,425	6,998	2,406	0
Island Lake	19,027	280	2,184	826	5,708	4,882	17,996	3,063
Kannah Creek	11,836	197	3,900	1,171	3,551	2,379	8,325	5,057
Lake City	25,721	97	1,351	435	7,716	7,282	1,363	516
Little Cone	22,420	117	43	128	6,726	6,598	8,591	4,866
Lone Cone	26,026	346	2,036	855	7,808	6,953	21,736	19,419
Los Pinos Creek	27,428	469	3,018	1,223	8,228	7,005	22,312	11,494

LAU Name	Total Lynx Habitat Acres	Road Acres	Activities Acres	Road (100% Impact)+ Activities (25% impact)= Estimated Impact Acres	30% of Lynx Habitat in the LAU	Maximum acres where understory vegetation impact from future activites may occur (See Design Feature WFRP-16)	Lynx Habitat that overlaps the Opportunity Area in the LAU	Lynx Habitat in Suitable Timber Areas in the LAU
Matterhorn	26,338	330	193	378	7,902	7,523	4,234	0
Mesa Lakes	17,823	170	1,073	438	5,347	4,909	12,293	4,934
Mount Gunnison	23,279	144	78	163	6,984	6,820	638	
Needle-Razor	20,960	285	5,520	1,665	6,288	4,623	3,578	2,037
Peeler Lakes (Kebler	23,626	167	35	175	7,088	6,912	3,486	517
Pitkin	49,154	1,275	3,136	2,059	14,746	12,687	10,022	3,503
Ragged Mountain	11,854	54	0	54	3,556	3,502	123	55
Red Creek	44,435	565	3,842	1,526	13,331	11,805	16,307	9,335
Rocky Brook	42,000	523	9,624	2,929	12,600	9,671	9,660	6,538
Sawtooth Mountain	29,063	210	1,331	543	8,719	8,176	10,395	2,514
Soap Creek	43,661	108	3,922	1,088	13,098	12,010	115	61
South Mamm Peak	11,269	30	3,646	941	3,381	2,440	0	0
Spring Creek	33,290	469	6,039	1,979	9,987	8,008	27,956	22,256
Stewart Creek	33,334	563	5,591	1,961	10,000	8,040	17,111	13,015
The Flat Tops	27,889	143	335	227	8,367	8,139	4,448	1,554

LAU Name	Total Lynx Habitat Acres	Road Acres	Activities Acres	Road (100% Impact)+ Activities (25% impact)= Estimated Impact Acres	30% of Lynx Habitat in the LAU	Maximum acres where understory vegetation impact from future activites may occur (See Design Feature WFRP-16)	Lynx Habitat that overlaps the Opportunity Area in the LAU	Lynx Habitat in Suitable Timber Areas in the LAU
Tincup	38,284	601	1,252	914	11,485	10,571	7,379	3,559
Traver Mesa NEW	35,974	457	4,590	1,605	10,792	9,187	28,872	24,016
Turret Ridge	26,922	175	0	175	8,076	7,901	6,553	1,270
Upper Taylor	31,228	380	760	570	9,368	8,798	4,727	2,673
Upper Tomichi	35,632	425	1,056	689	10,689	10,000	7,165	945
Whetstone Peak	15,633	64	0	64	4,690	4,626	3,257	1,371
Whitecross Mtn	6,974	49	8	51	2,092	2,041	375	22
Totals	**1,467,778**	**15,379**	**105,660**	**41,793**	**440,333**	**398,540**	**443,524**	**230,037**

Alternative 3 (Public Safety Focus) – Direct and Indirect Effects

Lynx

The environmental baseline statistics for lynx habitat are the same as those described in the Proposed Action (Table 70). There are 426,000 acres in opportunity areas for treatment under Alternative 3. The potential amount of acres in the lynx action areas considered in opportunity areas in Alternative 3 is 174,899 acres. Of those acres, 161,292 acres are lynx habitat. Of the lynx habitat that overlaps with Alternative 3 opportunity area, approximately 159,761 acres are mapped as suitable habitat and 1,531 acres are mapped as unsuitable habitat. There are 9,838 acres in LLAs considered in opportunity areas under Alternative 3 with 6,529 acres mapped as lynx habitat. Of the lynx habitat in the LLAs that overlap with Alternative 3 opportunity areas, there are 6,337 acres mapped as suitable habitat and 192 acres mapped as unsuitable habitat.

The types of treatments and the amount of annual and total acreage are the same and based on the same factors as described for Alternative 2. The alternative includes a maximum potential estimate of 10 miles of newly designed roads and 70 miles of temporary road compared to a maximum of 60 and 260 miles of new and temporary roads respectively in the proposed action. A maximum of 260 miles of road re-reconstruction may be needed, which is the same as the proposed action. There would also be more road maintenance activities because of hazard tree removal treatments along roads and the use of more existing roads to implement the alternative.

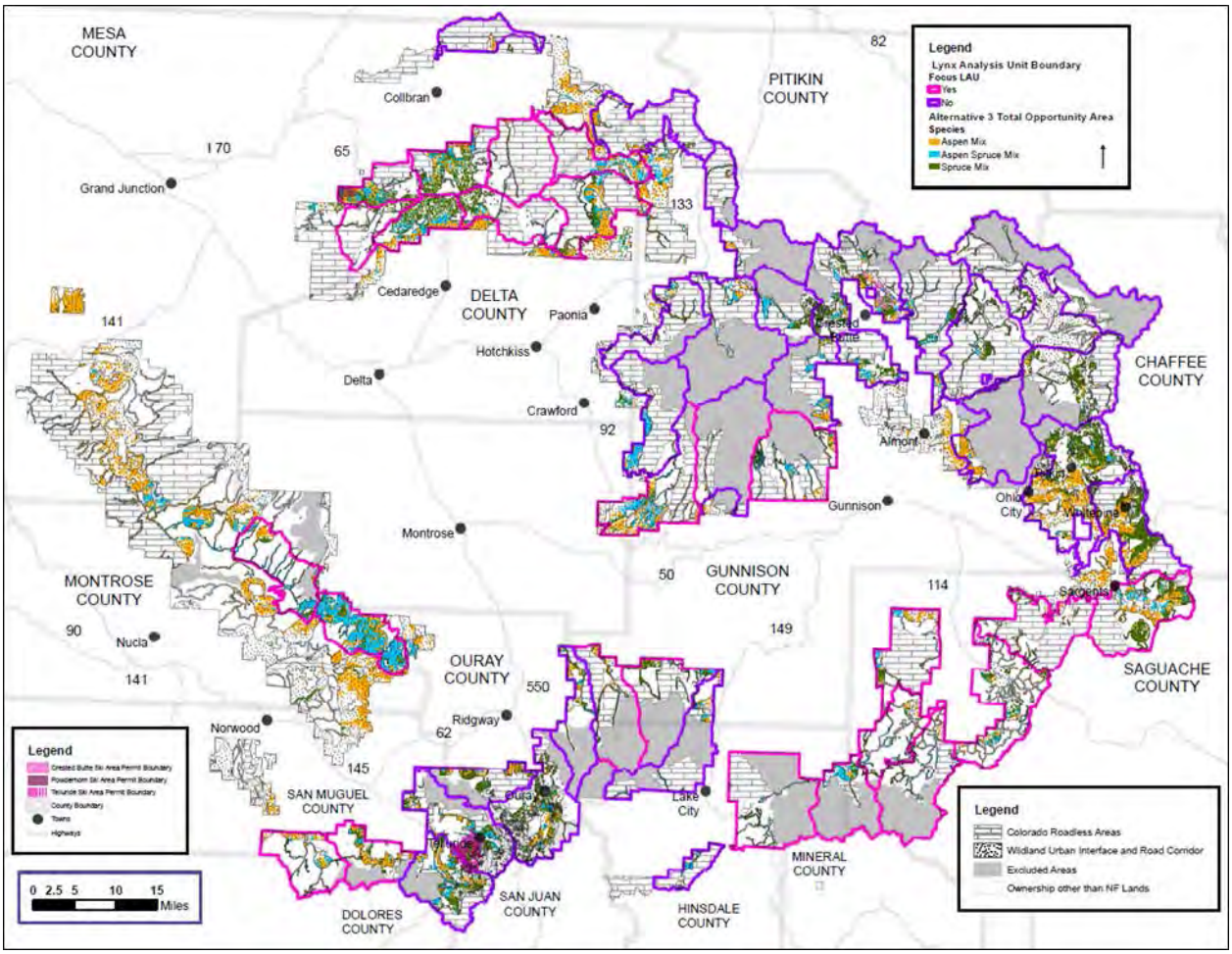


Figure 41. Opportunity acres under alternative 3 (public safety), which are common to all action alternatives.

The effects of commercial mechanical and non-commercial mechanical treatments to lynx are the same as those described in Alternative 2 with displacement of lynx likely to occur during implementation. Potential adverse impacts from increased vehicular traffic resulting in lynx-vehicle collisions is also the same as described under Alternative 2, but the number of route potentially used could be less since total opportunity acres are less. Vehicle traffic is not expected to exceed or even approach 2,000 vehicles per day.

Indirect effects would also be the same as described for the Proposed Action. Stand structure will still be altered as a result of Alternative 3, however, treatments will occur in areas that are in closer proximity to developed areas and to roads compared to the Proposed Action. There is a decrease of approximately 191,021 acres of suitable lynx habitat that is available for treatment under this alternative. However, because Alternative 3 is only focused on areas adjacent to roads and within WUI, treatment activities will result in improved conditions for fire and fuels management through creation of areas across the landscape from which firefighters can safely

and effectively manage or suppress fires for values at risk and/or resource benefit could be reduced.

There would be less road construction with a maximum of only 10 miles of newly designed road needed based on 60,000 acres of treatment over 10 years. This equals to a total of 24 acres of potential habitat loss for lynx compared to 145.5 acres of potential habitat loss for Alternative 2 due to road construction. As is the case with Alternative 2, the effect to LAUs due to road construction would be estimated once the location of roads is determined during implementation. Acres of permanent habitat loss would be tracked for SRLA purposes.

Since the focus of Alternative 3 is public safety, the priority for treatments will be in the WUI. Acres treated in WUI will be tracked under exemptions to SRLA standards VEG S1, S2 and S3 to ensure acreage allowances are not exceeded by the implementation of the SBEADMR project. Lynx may inhabit these areas, but it is unlikely due to the presence of humans and associated activities. This alternative will still benefit lynx because it will provide improved conditions where treatments occur. The improved conditions however will not be as widespread as in Alternatives 2 and 4. Therefore, Alternative 3 is likely to be less beneficial across the landscape for lynx than Alternatives 2 and 4.

Alternative 3 (Public Safety Focus) – Cumulative Effects

Lynx

The cumulative effects of Alternative 3, in combination with past, present, and reasonable foreseeable management actions, would be similar to those stated in the Proposed Action, however, effects would be limited to the opportunity area of Alternative 3. This concentration of treatments into a smaller area could lead to slightly higher cumulative effects within the smaller opportunity area of Alternative 3; however, with design features in place, effects would still be limited to those described in the proposed action.

Alternative 4 (Spruce Salvage) –Direct and Indirect Effects

Lynx

Alternative 4 limits spruce treatments to salvage only, (aspen treatments are the same as in the Proposed Action). No resiliency treatments would occur to create multi-storied stand conditions in spruce-fir. The amount of acres available for treatment is 718,000 acres; although there are more acres available for commercial treatment relative to Alternatives 2 and 3, the number of acres in LAUs including the number of habitat acres is the same as Alternative 2. This alternative also has the same maximum potential estimate of road miles, including the amount of designed roads, temporary roads and road re-construction.

Direct effects to lynx would be the same as described in Alternative 2. Both commercial mechanical and non-commercial mechanical methods would be used to implement Alternative 4 and the amount of acres available for treatment in LAUs and LLAs is the same. Temporary displacement of lynx and hares will occur due to the use of heavy machinery and the increased presence of personnel and vehicles. Mortality of lynx is unlikely to occur because they will likely leave treatment areas once activities begin. They will return to treatment areas once activities cease. Potential impacts due to increased vehicle traffic use from commercial treatments also remains the same but over a larger landscape, with increased potential to use an increased number of haul routes.

Indirect effects would be limited to those associated with salvage activities since no resilency treatments in spruce-fir would occur. Stand structure will still be altered with the salvage of dead and dying trees and habitat could be degraded. Changes to habitat for all vegetation management standards under the SRLA will be tracked as the project is implemented. The amount of habitat lost will be estimated during on the ground planning and surveys for each individual project. The loss of habitat due to the construction of roads will also be estimated during implementation.

Although this alternative does not include resiliency treatments in spruce-fir, treatment activities will benefit spruce-fir habitat by removing excess fuel caused by tree mortality which will result in the creation of improved conditions for fire and fuels management. Treatments will result in areas across the landscape from which firefighters can safely and effectively manage or suppress fires for values at risk and/or resource benefit. An added benefit of improved conditions for fire fighter safety and fuels management within WUI will be the increase in the potential use of natural ignitions that can be managed for resource benefit both within spruce-fir and aspen.

Alternative 4 – Cumulative Effects

Lynx

The cumulative effects of Alternative 4, in combination with past, present, and reasonable foreseeable management actions, would be similar to those stated in the Proposed Action, however, no effects from spruce resiliency treatments would occur. The spruce resiliency treatments in this project might tend to include more suitable lynx habitat, so cumulative effects of Alternative 4 as compared to the proposed action may be slightly lower. This is because treatments would focus on salvage of dead and dying trees, which tends not to be suitable lynx habitat. At the same time, treatments designed to maintain or encourage creation of multi-story stands would not occur. These treatments are important since they will create a diversity of age classes across the landscape benefitting lynx as well as making the stand less susceptible to beetles. In summary, this cumulative effects analysis concludes that in combination with all past, present, and reasonably foreseeable future activities within the LAUs, all standards and guidelines, exemptions and exceptions contained within the SRLA pertaining to habitat

thresholds would be met with the implementation of this project. Therefore, potential cumulative effects would not influence the overall effects determination. However, limiting cumulative impact at the LAU scale to 30% will help maintain the amount and distribution of lynx foraging habitat over time. Other design features to protect snowshoe hare habitat would provide additional protection.

Effects Determinations

Gunnison Sage-grouse

DETERMINATION FOR ALTERNATIVES 2, 3 and 4: It is determined that the actions will have NO EFFECT to the species or to the designated critical habitat.

The rationale: The closure of roads within 0.6 miles of a lek during the breeding and brooding period is a conservation measure implemented consistent with other efforts being implemented in the Gunnison Basin fro protection of the bird.

Lynx

DETERMINATION FOR ALTERNATIVES 2, 3 and 4: It is determined that all actions "MAY AFFECT, AND ARE LIKELY TO ADVERSELY AFFECT" the Canada lynx or its primary habitat.

The rationale:

- Habitat will be affected to varying degrees depending upon the alternative. Through layout and use of applicable design features during treatment implementation affects to lynx and their prey species will be minimized to the greatest extent practicable. However, due to the scale of the project and the types of actions some adverse effects could occur. The project is consistent with the SRLA which made a similar adverse effects determination while acknowledging the selected alternative was likely to have overall beneficial effects to lynx by addressing the primary therates identified during the time of listing. Incidental take as measured by habitat, allowed under the SRLA will be utilized and tracked annually through the life of the project. In the event that caps under SRLA are being approached during implementation, a Forest Plan amendment will be required followed by re-initiation of consultation with Fish and Wildlife Service
- Project design criteria would be in place to protect dense horizontal cover and minimize potential effects on lynx and their primary habitats in salvage and green tree management areas will be completed consistent with the SRLA. Limiting cumulative impact within a given LAU to 30% will further limit impacts and is consistent with conservation recommendation in the latest lynx assessment (Interagency Lynx Biology Team, 2013).
- Impacts from all action alternatives will not be discountable, insignicant or wholly beneficial.

Sensitive Species

Affected Environment

Table 79 includes sensitive species, or their habitats, that are located on the GMUG National Forest, or are located adjacent to or downstream of the planning area and could potentially be affected. A pre-field review was conducted of available information to assemble occurrence records, and describe habitat needs and ecological requirements. Prior to implementation, field reconnaissance would be completed for individual treatments resulting from the SBEADMR EIS.

No further analysis is needed for species that are not known or suspected to occur in the project area, and for which no suitable habitat is present. Table 79 documents the rationale for excluding a species. If suitable but unoccupied habitat is present, then potential effects are evaluated.

Table 79. List of Forest Service Sensitive Species

Common Name	Status	Known/suspected to be present?	Suitable habitat present?	Rationale if not carried forward for analysis
Northern goshawk	Forest Service Sensitive	Yes	Yes	(Carried forward)
Boreal owl	Forest Service Sensitive	Yes	Yes	(Carried forward)
Burrowing owl	Forest Service Sensitive	No	No	There is no suitable habitat within the SBEADMR project opportunity area where treatments may occur. No treatments will occur in open grassland habitat.
American bittern	Forest Service Sensitive	No	No	There is no suitable habitat within the SBEADMR project opportunity areas where treatments may occur. No treatments will occur in marsh habitat.
Sage sparrow	Forest Service Sensitive	No	No	There is no suitable habitat within the SBEADMR project opportunity areas where treatments may occur. No treatments will occur in sagebrush habitat.
Ferruginous hawk	Forest Service Sensitive	No	No	There is no suitable habitat within the SBEADMR project opportunity areas where treatments may occur. No treatments will occur in open grassland habitat.
Northern harrier	Forest Service Sensitive	No	No	There is no suitable habitat within the SBEADMR project opportunity areas where treatments may occur. No treatments will occur in marshes or open grasslands.
Olive-sided flycatcher	Forest Service	Yes	Yes	(Carried forward)

Common Name	Status	Known/suspected to be present?	Suitable habitat present?	Rationale if not carried forward for analysis
	Sensitive			
Black swift	Forest Service Sensitive	No	No	There is no suitable habitat within the SBEADMR project opportunity areas where treatments may occur. No treatments will impact cliffs or waterfalls. Perennial streams will be buffered following direction in the Water Conservation Practices Handbook.
American peregrine falcon	Forest Service Sensitive	No	No	There is no suitable habitat within the SBEADMR project opportunity areas where treatments may occur. No treatments will impact cliffs and surrounding habitats.
Bald eagle	Forest Service Sensitive	Yes	Yes	Pairs of eagles have been documented across the GMUG and while suitable habitat is present on the GMUG, there is no suitable habitat within the SBEADMR project opportunity areas where treatments may occur. No treatments will occur around lakes, rivers or large waterbodies.
White-tailed ptarmigan	Forest Service Sensitive	No	No	There is no suitable habitat within the SBEADMR project opportunity areas where treatments may occur. No treatments will occur in high elevation meadow habitat, the upper limit of the subalpine zone (subalpine and alpine transition zone) and alpine areas.
Loggerhead shrike	Forest Service Sensitive	No	No	There is no suitable habitat within the SBEADMR project opportunity areas where treatments may occur. No treatments will occur in open woodlands.
Lewis's woodpecker	Forest Service Sensitive	No	No	There is no suitable habitat within the SBEADMR project opportunity areas where treatments may occur. No treatments will occur in low elevation ponderosa pine forests or deciduous forests/cottonwood corridors along streams. There are documented occurrences of this species along rivers and major creeks and in cottonwood forests.
Flammulated owl	Forest Service Sensitive	Yes	Yes	(Carried forward)
Purple martin	Forest Service Sensitive	Yes	Yes	(Carried forward)
Brewer's sparrow	Forest Service Sensitive	No	No	There is no suitable habitat within the SBEADMR project opportunity areas where treatments may occur. No treatments will occur in sagebrush habitat.

Common Name	Status	Known/suspected to be present?	Suitable habitat present?	Rationale if not carried forward for analysis
Columbian sharp tailed grouse	Forest Service Sensitive	No	Yes	There is no suitable habitat within the SBEADMR project opportunity areas where treatments may occur. No treatments will occur in open grassland or mountain shrub habitat.
Boreal Toad	Forest Service Sensitive, Candidate	Yes	Yes	(Carried forward)
Northern leopard frog	Forest Service Sensitive	Yes	Yes	(Carried forward)
Townsend's big-eared bat	Forest Service Sensitive	No	No	There is no suitable habitat within the SBEADMR project opportunity areas where treatments may occur. No treatments will impact caves, mines or structures.
Spotted bat	Forest Service Sensitive	No	No	There is no suitable habitat within the SBEADMR project opportunity areas where treatments may occur. In Colorado, this species is known to occur near Dinosaur Monument and at lower elevations on the Western Slope including the Four Corners area. (CPW website).
Hoary bat	Forest Service Sensitive	Yes	Yes	(Carried forward)
River otter	Forest Service Sensitive	No	Yes	There is no suitable habitat within the SBEADMR project opportunity areas where treatments may occur. No treatments will impact rivers or waterbodies.
North American wolverine	Forest Service Sensitive	Yes	Yes	(Carried forward)
American marten	Forest Service Sensitive	Yes	Yes	(Carried forward)
Fringed myotis	Forest Service Sensitive	No	Yes	There is no suitable habitat within the SBEADMR project opportunity areas where treatments may occur. No treatments will impact caves, mines or structures.
Rocky Mountain bighorn sheep	Forest Service Sensitive	No	No	There is no suitable habitat within the SBEADMR project opportunity areas where treatments may occur. No treatments will occur in suitable habitat for this species.
Desert bighorn sheep	Forest Service	No	No	There is no suitable habitat within the SBEADMR project opportunity areas where treatments may occur. No treatments will occur

Common Name	Status	Known/suspected to be present?	Suitable habitat present?	Rationale if not carried forward for analysis
	Sensitive			in suitable habitat for this species.
Pygmy shrew	Forest Service Sensitive	Yes	Yes	(Carried forward)
Kit fox	Forest Service Sensitive	No	No	There is no suitable habitat within the SBEADMR project opportunity areas where treatments may occur. No treatments will occur in suitable habitat for this species.
Gunnison's prairie dog	Forest Service Sensitive	Yes	Yes	There is no suitable habitat within the SBEADMR project opportunity areas where treatments may occur. No treatments will occur in grassland habitat.
White-tailed prairie dog	Forest Service Sensitive	Yes	Yes	There is no suitable habitat within the SBEADMR project opportunity areas where treatments may occur. No treatments will occur in grassland habitat. There are no confirmed sightings of this species on the Forest.

Alternative 1 (No Action) – Direct and Indirect Effects on Sensitive Species

There will be no human-induced direct effects as a result of Alternative 1. There would be no treatments under this alternative and stands would remain as they exist.

There would be indirect effects with the No Action alternative. Since no treatments would occur, standing dead spruce would continue to exist until they are blown down and fall from deterioration. This will increase fuel loads in bark beetle infested areas increasing the risk of a fire becoming of high intensity resulting in a possible stand replacing event.

Under the No Action alternative, it may also take more time for stands to regenerate and re-establish where seed sources are lacking. No planting of trees would occur and as dead trees fall onto the ground, it may slow the growth of seedlings if a heavy accumulation of fallen trees occurs which may block the passage of light and nutrients to seedlings.

Alternative 1 (No Action) – Cumulative Effects on Sensitive Species

Under the No Action alternative there would be no cumulative effects because no federal actions would occur to add to activities occurring in the past, present or in the future.

Alternative 2 (Proposed Action) – Direct and Indirect Effects on Sensitive Species

Northern Goshawk

In general, direct effects to northern goshawks from treatment activities include noise due to the presence of heavy equipment operations, chainsaws, the presence of personnel and smoke

associated with prescribed fire activities. Noise disturbance and smoke may result in the temporary displacement of goshawks during treatment activities. Design features included in the proposed action and in compliance with Forest Plan direction will restrict activities during the breeding season and will also require raptor surveys to determine the locations of individuals (particularly active nest sites) or populations each year. These design features will minimize impacts to active goshawk nest sites and provide protection to these sites during implementation of the proposed action.

Goshawks have been primarily documented to nest in lodgepole and mature aspen stands. It is unlikely that treatments to spruce-fir will affect nesting habitat for goshawks. It may, however affect foraging habitat. Table 80 is a summary of effects to goshawks as a result of proposed silvicultural prescriptions.

Table 81 is a summary of effects to goshawks, flammulated owls and purple martins in aspen stands.

The proposed action would also reduce ground and surface fuels through the removal of dead and dying trees. Prescribed fire treatments such as pile burning will also reduce fuels generated by treatment activities. Fuel treatments would also benefit northern goshawks and their habitat in the long term by improving the health of forested stands by increasing age diversity and promoting regeneration. In addition, resiliency treatments would increase age class diversity and tree species composition which would increase the diversity of habitats for goshawks, with particular benefit of increased forage area.

Flammulated Owl

Direct effects to owls include noise disturbance and smoke associated with prescribed fire activities. Noise disturbance resulting from the use of heavy equipment, chainsaws and personnel implementing the project as well as smoke may cause the temporary displacement of roosting owls. Project activities will also remove suitable habitat which could result in the permanent displacement of owls if they are using areas where pockets of trees are removed.

Flammulated owls do not use spruce-fir stands, but will utilize aspen, and aspen dominated stands that have spruce or pine within it. Treatments in spruce-fir stands are not expected to affect flammulated owls. Indirect effects to flammulated owls and their habitat are included in

Table 81.

Purple Martin

Purple Martin prefer mature aspen as their primary habitat. Direct effects to purple martins include noise disturbance associated with the use of heavy equipment and chainsaws and the presence of personnel during treatment activities. All of these effects may cause individuals in the area to temporarily displace to adjacent areas. Displacement of individuals during the breeding season may result in nest abandonment. It may also affect nest success if birds are spending more time avoiding activities rather than foraging and delivering food to chicks.

Table 81 includes effects of aspen treatments to martin habitat based on suckering potential and treatment prescriptions. . All treatments will result in a temporary loss of habitat. Aspen will regenerate over time and habitat will be restored in the long term. Mixed conifer-aspen stands not treated to remove conifer will become conifer dominated and resulting in a permanent loss of aspen habitat. Resiliency treatments in mixed conifer-aspen stands have the primary objective of conifer removal to maintain the aspen component. All action alternatives for aspen will result in the continued existence of habitat for martins with improved conditions.

Table 80. Effects of proposed silvicultural prescriptions to goshawks in spruce – fir stands.

Stand Condition	Overstory Mortality Level	Treatment	Effects to Goshawk Habitat
Single Storied	<40%	• Individual tree selection. • Removal focused on pockets of live, dead or dying spruce-fir. • Harvest 15-25% of stand. • May require mechanical site prep.	Spruce fir stands are not preferred by goshawk as nesting/roosting habitat on the GMUG but goshawks will utilize these stands for foraging. Treatments will remove individual or pockets of trees with the majority of the area remaining as it exists. Habitat for prey species will be affected in patches due to decreases in canopy cover, stand density and coarse woody debris. WFRP-3 and 6 will ensure maintenance of down woody debris and protection of habitat directly around nest sites and disturbance from operations when nests are active. Overall, foraging habitat will remain across the landscape.
	Between 40-90%	• Remove all dead and dying spruce-fir in areas where adequate seed source exists. • Group selection where mortality is patchy. • Clear cut where mortality is extensive. • Create small openings in areas where <40% mortality occurs. • Maximum removal is 40% of present stocking within residual stand to maintain wind "firmness". • May require mechanical site prep.	These stands may be used by goshawks as foraging habitat. Treatments may degrade habitat for prey species because of a decrease in canopy cover, stand density and coarse woody debris. As a result foraging habitat may also be degraded. Design features WFRP-2, 3, 6 and 10 will ensure maintenance of snags and retention of down woody debris and protection of habitat directly around occupied nest sites from disturbance during operations, and maintaining uncut areas important for foraging habitat. Overall, foraging habitat will remain across the landscape. Stands will also have lower canopy cover across the landscape as a result of proposed treatments. Goshawks require canopy cover over 40% and it is likely the majority of stands will fall below that level as trees die and fall or as a result of treatment. In areas where canopy cover is low, goshawks are unlikely to use those areas. Still patches of habitat may be available after treatments are completed and goshawks may use it depending on the size and proximity suitable habitat. As a result, treatments will likely result in low quality foraging habitat at best for goshawks.
	>90%	• Remove all dead and dying spruce-fir where there is no adequate natural seed source. • Clear cut where mortality is extensive. • May require mechanical site prep.	Due to the lack of overstory canopy cover, goshawks are not expected to utilize these areas. Stands in these areas will be too open after treatments with decreased canopy cover, stand density, coarse woody debris as well as the incidental reduction in understory vegetation components. All of these factors may degrade habitat for prey species, decreasing the quality of foraging habitat available. Overall, suitable habitat will not exist and is unlikely to exist in the immediate future. Design features WFRP-2, 3 and 10 will help ensure maintenance of snags and retention of down woody debris and maintenance of a suitable understory for various prey species across the landscape. When nest sites are discovered in the planning area, WFRP- 6 will be applied providing protection of habitat directly around occupied nest sites from disturbance during operations, and maintaining uncut areas important for foraging habitat

Stand Condition	Overstory Mortality Level	Treatment	Effects to Goshawk Habitat
Two Storied	<40% and ≥35% DHC and advanced regeneration above mean snow depth	• Individual tree selection or group selection in 0.25 to 2 acre openings. • Removal focused on pockets of dead and dying spruce-fir.	Although spruce fir has been found not to be a preferred nesting habitat type for goshawks on the GMUG, these stands could provide suitable nesting/roosting habitat if the stand contains large trees and high canopy cover. Otherwise the area is suitable foraging habitat. Treatments will have a minimal effect to goshawk habitat. Only pockets of trees or individual trees will be removed. Habitat for prey species will be affected in patches, but is not expected to result in changes in overall population abundance. Foraging habitat will be maintained across the landscape. Treatments are intended to create multiple age classes of trees and increase This will also result in stands continuing to support goshawk foraging habitat and will decrease the chances of habitat loss in the future.
	<40% and <35%DHC	• Individual tree selection or group selection in 0.25 to 2 acre openings. • Remove dead and dying spruce-fir.	These stands may provide nesting/roosting and foraging habitat as long as there is a dense canopy cover. Treatments will affect habitat in these areas with the removal of individual or groups of trees, leaving openings that goshawks will not forage in. Foraging habitat may be degraded due to decreases in canopy cover, stand density and coarse woody debris which are important habitat elements for prey species. Design features WFRP-2, 3 and 10 will help ensure maintenance of snags and retention of down woody debris and maintenance of a suitable understory for various prey species across the landscape. When nest sites are discovered in the planning area, WFRP- 6 will be applied providing protection of habitat directly around occupied nest sites from disturbance during operations, and maintaining uncut areas important for foraging habitat
	Between 40-90% and ≥35% DHC and advanced regeneration above mean snow depth	• Salvage of dead and dying. • Follow uneven aged management prescriptions in areas where mortality is lower. • Remove live trees that pose a blow down risk. • Maximum removal is 40% of present stocking within residual stand to maintain wind “firmness”.	Foraging habitat for goshawks may not exist in these stands but is likely marginal at best. Canopy cover is not likely to exceed 40% except in patches due to the amount of mortality in these stands. Treatments are expected to further decrease canopy cover, stand density and coarse woody debris which are important habitat elements for prey species. Design features WFRP-2, 3 and 10 will help ensure maintenance of snags and retention of down woody debris and maintenance of a suitable understory for various prey species across the landscape. When nest sites are discovered in the planning area, WFRP- 6 will be applied providing protection of habitat directly around occupied nest sites from disturbance during operations, and maintaining uncut areas important for foraging habitat.
	Between 40% and 90% and <35%DHC	• Salvage of dead and dying. • Follow uneven aged management prescriptions in areas where mortality is lower. • Remove live trees that pose a blow down risk. • Maximum removal is 40% of present stocking within	Foraging habitat may not exist, but is marginal quality at best. Treatments will decrease canopy cover, stand density and coarse woody debris which may also degrade habitat for prey species. Goshawks are not likely to utilize these stands because canopy cover will be low on average across the stand with pockets of habitat available at best. Design features WFRP-2, 3 and 10 will help ensure maintenance of snags and retention of down woody debris and maintenance of a suitable understory for various prey species across the landscape. When nest sites are discovered in the planning area, WFRP- 6 will be applied providing protection of habitat directly around occupied nest sites from disturbance during operations, and maintaining uncut areas important for

Stand Condition	Overstory Mortality Level	Treatment	Effects to Goshawk Habitat
		residual stand to maintain wind "firmness".	foraging habitat.
	>90% and ≥35% DHC and advanced regeneration above mean snow depth or >90% and <35%DHC	• Stand no longer two storied due to dead overstory. • Salvage of dead and dying spruce-fir.	These stands may not be used by goshawks due to the lack of canopy cover and live trees because of high mortality in the stands. Treatments will not affect goshawks. Design features WFRP-2, 3 and 10 will help ensure maintenance of snags and retention of down woody debris and maintenance of a suitable understory for various prey species across the landscape. When nest sites are discovered in the planning area, WFRP- 6 will be applied providing protection of habitat directly around occupied nest sites from disturbance during operations, and maintaining uncut areas important for foraging habitat
Multiple Canopies	<40% ≥35% DHC and advanced regeneration above mean snow depth	• Individual tree selection or group selection in 0.25 to 2 acre openings. • Removal focused on pockets of dead and dying spruce-fir.	Spruce fir is not a preferred habitat type for goshawks for nesting/roosting however these stands may provide suitable habitat if canopy cover is >40% and large trees occur in the stand. They can be used as foraging habitat for goshawks and treatments may degrade the availability of forage where patches of trees are removed. In these areas, canopy cover and understory components would be lost which may degrade prey species habitat and decrease prey populations. However, at a landscape level, these stands are expected to continue to support foraging habitat and possibly nesting/roosting habitat. When nest sites are discovered in the planning area, WFRP- 6 will be applied providing protection of habitat directly around occupied nest sites from disturbance during operations, and maintaining uncut areas important for foraging habitat.
	<40% and <35%DHC	• Individual tree selection or group selection in 0.25 to 2 acre openings. • Removal focused on pockets of dead and dying spruce-fir.	These stands may provide suitable nesting/roosting if there is a dense canopy cover however it would be low quality habitat because it is a single storied stand. These stands are suitable foraging habitat and treatments may degrade habitat with the removal of individual or groups of trees resulting in decreases in canopy cover, stand density and coarse woody debris which are important habitat elements for prey species. When nest sites are discovered in the planning area, WFRP- 6 will be applied providing protection of habitat directly around occupied nest sites from disturbance during operations, and maintaining uncut areas important for foraging habitat.
	Between 40 and 90% and ≥35% DHC and advanced regeneration above mean snow depth	• Salvage of dead and dying. • Follow uneven aged management prescriptions in areas where mortality is lower. • Remove live trees that pose a blow down risk. • Maximum removal is 40%	These stands are low quality foraging habitat and are not likely to be used by goshawk due to the low canopy cover and stand density as a result of mortality within the stand. Patches of suitable foraging habitat may exist and treatments will reduce canopy cover, stand density, coarse woody debris and understory vegetation components which may degrade prey species habitat and decrease the amount of available prey. Design features WFRP-2, 3 and 10 will help ensure maintenance of snags and retention of down woody debris and maintenance of a suitable understory for various prey species across the landscape. When nest sites are discovered in the

Stand Condition	Overstory Mortality Level	Treatment	Effects to Goshawk Habitat
		of present stocking within residual stand to maintain wind "firmness".	planning area, WFRP- 6 will be applied providing protection of habitat directly around occupied nest sites from disturbance during operations, and maintaining uncut areas important for foraging habitat..
	Between 40 and 90% and <35%DHC	• Salvage of dead and dying. • Follow uneven aged management prescriptions in areas where mortality is lower. • Remove live trees that pose a blow down risk. • Maximum removal is 40% of present stocking within residual stand to maintain wind "firmness".	Goshawks may use these stands as foraging habitat although they are likely low to marginal quality at best. Canopy cover is likely to average less than 40% because of mortality levels and pockets of suitable habitat may be present. Treatments may further degrade habitat with the removal of trees and decreases in canopy cover, stand density, coarse woody debris and understory habitat components. Prey species may decrease which affect forage availability for goshawks. Overall, these areas will not support high quality habitat. Design features WFRP-2, 3 and 10 will help ensure maintenance of snags and retention of down woody debris and maintenance of a suitable understory for various prey species across the landscape. When nest sites are discovered in the planning area, WFRP- 6 will be applied providing protection of habitat directly around occupied nest sites from disturbance during operations, and maintaining uncut areas important for foraging habitat.
	>90% ≥35% DHC and advanced regeneration above mean snow depth or >90% and <35%DHC	• If two canopies still alive, it is a multi-storied stand. • Salvage of dead and dying.	These stands are unlikely to be used by goshawks due to the lack of canopy cover and live trees as a result of the high mortality in the stands. Treatments will not affect goshawks. Design features WFRP-2, 3 and 10 will help ensure maintenance of snags and retention of down woody debris and maintenance of a suitable understory for various prey species across the landscape. When nest sites are discovered in the planning area, WFRP- 6 will be applied providing protection of habitat directly around occupied nest sites from disturbance during operations, and maintaining uncut areas important for foraging habitat

Table 81. Effects of Proposed Silvicultural Prescriptions to Northern Goshawks, Flammulated Owls, Purple Martin in Aspen Stands

Aspen Stand Condition	Suckering Potential	Treatment	
No SAD or <50% SAD in stands	High	• Coppice treatments of aspen if tree defect is low to high. • Prescribed burn feasible if there is a moderate fine fuel component.	Coppice treatments in stands will result in short-term loss of habitat for goshawks, flammulated owls and purple martin. Where prescribed burning is applied, fuel loads will be reduced including downed logs, grasses, shrubs, snags and live mature trees. Breeding habitat would initially be lost but in the long term treatments are intended to to assist aspen to persist on the landscape, maintaining habitat for all species utilizing this tree type.
	Low	• No treatment	No treatment, therefore no effect.
>50% SAD in stands.	High	• Treatment-specific prescriptions to be determined based on site conditions.	Habitat may be degraded or lost if stands are thinned or if coppice treatments are used. Typically, these are low priority treatment areas since regeneration of the stand has shown to have low success.
	Low	• Allow continued succession of stand. • Plant site adapted conifer species as an option.	Stands will not support suitable habitat if conifers become the dominant species.
Aspen Overstory with Spruce Fir Understory	High	• Defer aspen cut and allow stand to succeed as a spruce-fir dominated stand.	Coppice treatments will temporarily result in a loss of habitat. Over time, aspen are expected to regenerate and will support aspen dependent species.
	Low	• Coppice (clear cut) treatments of aspen if tree defect is low to high. • Prescribed burn to stimulate aspen where appropriate. • Remove fir and aspen to stimulate additional aspen.	Stands will continue to support aspen and provide habitat for goshawks, flammulated owls and martins.

Mixed Conifer with Aspen	High	• Remove spruce-fir and allow stand to succeed as an aspen dominated stand. • Use prescribed fire as needed to reduce fuels and regenerate aspen.	Treatments in stands will include coppice cuts in patches across entire stands. This will result in a temporary loss of habitat. Aspen will regenerate over time and once stands are re-established, provide suitable habitat for goshawk, flammulated owl and martins will exist.
	Low	• Coppice treatments in patches within the entire stand. • Pile burn as needed. • Use prescribed fire as needed to reduce fuels and regenerate aspen	The removal of spruce-fir in stands will allow aspen to become the dominant tree species in these stands. This will also improve habitat conditions for species utilizing aspen stands as habitat.

Boreal Owl

Direct effects to owls include noise disturbance and smoke associated with prescribed fire activities. Noise disturbance resulting from the use of heavy equipment, chainsaws and personnel implementing the project as well as smoke may cause the temporary displacement of roosting owls. Project activities may also remove suitable habitat which could result in the permanent displacement of owls if they are using areas where pockets of trees are removed.

Indirect effects to spruce-fir habitat for boreal owl are included in Table 82. Treatments proposed in aspen stands will not affect boreal owls because it is not suitable habitat.

Olive-sided Flycatcher

Direct effects to olive-sided flycatchers include noise due to the presence of heavy equipment operations, chainsaws, the presence of personnel and smoke associated with prescribed fire activities. Noise disturbance and smoke may result in the temporary displacement of flycatchers in the area. This could cause nest abandonment if they are using these areas as nesting habitat, or could affect nest success if birds spend more time avoiding these disturbances rather than foraging and delivering food to chicks.

Indirect effects include changes in habitat structure and composition within all treatment units. Salvage logging, by reducing snag densities, may diminish site quality particularly if larger snags, which olive-sided flycatchers prefer (Altman and Sallabanks 2000, Brandy 2001), are selectively removed. However, this species has been found to nest in logged forests, but not in clear cuts (Kotliar 2007). There are studies that have found that logged areas provide nesting habitat, however there is conflicting evidence as to the relative suitability of these areas (Kotliar and Melcher 1998, Hutto and Young 1999). In studies comparing burned forests with logged forests, results have shown both higher and lower nesting success in burned areas (Smucker and Smucker 2001, Meehan and George 2003). Studies have also shown that logged areas likely provide better forage than burned areas based on higher feeding rates (Meehan and George 2003). This was even found in studies where burned areas had higher nesting success than logged areas (Meehan and George 2003). Based on all of this information, disturbance events including logging activities do not necessarily result in negative impacts to olive sided flycatchers. What isn't known is whether it's the type of disturbance, the scale, severity, or elapsed time since the disturbance occurred that affects habitat suitability (Kotliar, 2007). Maintaining clumps of trees and snags are important to maintaining nesting habitat for flycatchers. The proposed project includes design features that will maintain these elements in areas where salvage activities occur. This will help to minimize adverse effects to flycatchers. A description of indirect effects to habitat due to silvicultural treatments is described in Table 82.

The proposed action will also reduce ground and surface fuels through the removal of dead and dying trees. Prescribed fire treatments such as pile burning will also reduce fuels generated by

treatment activities. The reduction of fuels will help to slow the rate of spread of a fire compared to existing conditions.

Pygmy Shrew

Direct effects to pygmy shrews could potentially include trampling and crushing due to the use of heavy equipment and the increase presence of humans. There are no recorded observations of this species in areas available for treatment however this species is small and not easily seen as they tend to blend in with their habitat. This is likely one of the reasons there is little information about their population. Indirect effects to habitat are described in Table 82. Pygmy shrews do not use aspen as habitat and treatments to aspen stands will have no effect to them.

The proposed action would also reduce ground and surface fuels through the removal of dead and dying trees in treated areas. Prescribed fire treatments such as pile burning would also reduce fuels generated by treatment activities. The reduction of fuels would help to slow the rate of spread of a fire in treated areas compared to existing conditions.

Table 82. Effects of Proposed Silvicultural Prescriptions in Spruce Fir to Boreal Owl, Olive sided Flycatcher, and Pygmy Shrew.

Stand Condition	Overstory Mortality Level	Treatment	Effects to Habitat
Single Storied	<40%	• Individual tree selection. • Removal focused on pockets of dead and dying spruce-fir. • Harvest 15-25% of stand. • May require mechanical site prep.	Treatments will slightly alter habitat conditions for the boreal owl, olive sided flycatcher and pygmy shrew. Open pockets will occur within stands and stand density will slightly decrease in some areas which may improve foraging habitat for flycatchers. Overall stands will continue to provide suitable habitat across the landscape.
	Between 40-90%	• Remove all dead and dying spruce-fir in areas where adequate seed source exists. • Group selection where mortality is patchy. • Clear cut where mortality is extensive. • Create small openings in areas where <40% mortality occurs. • Maximum removal is 40% of present stocking within residual stand to maintain wind "firmness". • May require mechanical site prep.	Habitat for all of these species may be degraded or lost as a result of treatment activities. There will be a decrease in canopy cover, stand density, and coarse woody debris with group selection treatments. This may degrade habitat for the pygmy shrew as well as habitat for boreal owl prey species resulting in a decrease in prey availability. Design feature WFRP-4 will minimize effects to coarse woody debris levels which will retain some habitat components for small mammal species. Decrease or loss of canopy cover and stand density may degrade the quality of habitat for all species. Flycatchers may continue to utilize the area if there are snags and patches of live trees remaining. A design feature WFRP-2 that requires retaining 90-225 snags per 100 acres across the landscape will maintain habitat for the owl and flycatcher. WRRP- 8 and 10 will retain live trees in salvaged areas and patches of high quality lynx foraging habitat in blocks greater than 0.3 acres or larger should provide standing snags and understory habitats for fly catchers. Maintence of the understory should provide thermal cover for shrews.
	>90%	• Remove all dead and dying spruce-fir where there is no adequate natural seed source. • Clear cut where mortality is extensive. • May require mechanical site prep.	These stands provide low quality to marginal habitat for all of the species analyzed in this table. Treatments will decrease or remove canopy cover, stand density and coarse woody debris as well as an incidental reduction in understory vegetation within treated areas. WFRP-10 will maintain patches of habitat greater than 0.3 acres supporting high quality lynx foraging habitat will be retained in treatment areas providing some habitat pygmy shrew and boreal owl but they will have limited use due to their small size. Within treatment areas, these stands will no longer support suitable habitat for any of the species and it will take years for suitable habitat to regenerate. WFRP – 2,3,4,5,8, 10 and 15 will help ensure habitat for boreal owls, flycatchers and shrews across the broader landscape where treatments are proposed.

Stand Condition	Overstory Mortality Level	Treatment	Effects to Habitat
Two Storied	<40% and ≥35% DHC and advanced regeneration above mean snow depth	• Individual tree selection or group selection in 0.25 to 2 acre openings. • Removal focused on pockets of dead and dying spruce-fir.	Treatments will slightly alter habitat conditions for the boreal owl, olive sided flycatcher and pygmy shrew. Open pockets will occur within stands and stand density will slightly decrease in some areas which will may improve foraging habitat for flycatchers. Stands will continue to provide suitable habitat for all species across the landscape. Habitat quality for small mammals may also decrease in quality but only in patches. Distribution of prey for boreal owls may be affected, but small mammal populations will not result in any significant change. Treatments are intended to make stands more resilient to future bark beetle attacks which will decrease the chances of habitat loss in the future.
	<40% and <35%DHC	• Individual tree selection or group selection in 0.25 to 2 acre openings. • Remove dead and dying spruce-fir.	Treatments will slightly alter habitat conditions for species included listed above. Open pockets will occur within stands and stand density will slightly decrease in some areas which will continue to provide suitable foraging habitat for flycatchers. Habitat for small mammal species is low quality with the low percent of DHC in the stands. Treatments may further degrade habitat for these species with a decrease and loss of canopy cover and stand density. These changes would result in loss or degradation of habitat for shrews and other small mammals that are prey for boreal owls. Design features for coarse woody debris and snag retention will retain some of those features maintaining some habitat in stands after treatments. Patches of habitat for all of the bird species and the shrew would be lost or degraded with the group selection prescription. Treatments are intended to increase age class divserity and tree species composition making stands more resilient to future bark beetle attacks which will decrease the chances of more habitat loss in the future.
	Between 40-90% and ≥35% DHC and advanced regeneration above mean snow depth	• Salvage of dead and dying. • Follow uneven aged management prescriptions in areas where mortality is lower. • Remove live trees that pose a blow down risk. • Maximum removal is 40% of present stocking within residual stand to maintain wind “firmness”.	Habitat for all of these species may be degraded or lost as a result of treatment activities. There will be a decrease in canopy cover, stand density, and coarse woody debris with group selection treatments. This may degrade habitat for the pygmy shrew as well as habitat for boreal owl prey species resulting in a decrease in prey availability. Design features will minimize effects to coarse woody debris levels which will retain some habitat components for small mammals. Decreases in canopy cover and stand density may degrade the quality of habitat for all species. A design feature that requires retaining 90-225 snags per 100 acres across the landscape will maintain this habitat component for the owl and flycatcher. Thermal cover may be affected by treatment activities for the shrew, but it will depend on the remaining understory. However, WFRP – 2,3,4,5,8, 10 and 15 will help ensure retention of habitat for boreal owls, flycatchers and shrews across the broader landscape even though it may be of lower quality due to high overstory tree mortality..

Stand Condition	Overstory Mortality Level	Treatment	Effects to Habitat
	Between 40% and 90% and <35%DHC	• Salvage of dead and dying. • Follow uneven aged management prescriptions in areas where mortality is lower. • Remove live trees that pose a blow down risk. • Maximum removal is 40% of present stocking within residual stand to maintain wind "firmness".	Habitat for all of these species is low quality and may be degraded further with salvage activities. All activities will lower the amount of coarse woody debris in stands which will affect shrews and small mammals that are prey for boreal owls. Design features will minimize effects to coarse woody debris levels and retain snags across the landscape which will maintain some habitat. Changes and loss of canopy cover and stand density may degrade the quality of habitat for all species. Because mortality is between 40% and 90%, untreated stands will likely be left with patches of low quality habitat in the matrix that may not be of sufficient size to support high densities of boreal owl or flycatchers across the broader landscape. However, WFRP – 2,3,4,5,8, 10 and 15 will help ensure retention of habitat for boreal owls, flycatchers and shrews across the broader landscape even though it may be of lower quality due to high overstory tree mortality..
	>90% and ≥35% DHC and advanced regeneration above mean snow depth or >90% and <35%DHC	• Stand no longer two storied due to dead overstory. • Salvage of dead and dying spruce-fir.	These stands are unlikely to support suitable habitat for the boreal owl or flycatchers. Due to the amount of mortality in the stand, canopy cover and stand density would already be absent or low and highly degraded. Habitat for shrews may still occur if there is a developed understory that can provide cover, shelter and food. Treatments may further degrade any suitable habitat that remains and it is likely treatment areas will not support any of these species in the immediate future. However, WFRP – 2,3,4,5,8, 10 and 15 will help ensure retention of habitat for boreal owls, flycatchers and shrews across the broader landscape even though it may be of lower quality due to high overstory tree mortality..
Multiple Canopies	<40% ≥35% DHC and advanced regeneration above mean snow depth	• Individual tree selection or group selection in 0.25 to 2 acre openings. • Removal focused on pockets of dead and dying spruce-fir.	Treatments will slightly alter habitat conditions for the boreal owl, olive sided flycatcher and pygmy shrew. Open pockets will remain after treatments within stands and stand density will slightly decrease in some areas and may improve foraging habitat for flycatchers. Stands will continue to provide suitable habitat across the landscape for all species especially in areas where more than one story remains. Habitat for small mammal species will also be affected in patches, but populations for shrews and prey species for the boreal owl are not expected to result in any significant change to populations. Treatments are intended to increase age class diversity and tree species composition making stands more resilient to future bark beetle attacks which will decrease the chances of more habitat loss in the future.

Stand Condition	Overstory Mortality Level	Treatment	Effects to Habitat
	<40% and <35%DHC	• Individual tree selection or group selection in 0.25 to 2 acre openings. • Removal focused on pockets of dead and dying spruce-fir.	Treatments will slightly alter habitat conditions for species included listed above. Open pockets will occur within stands and stand density will slightly decrease in some areas which may improve foraging habitat for flycatchers. Habitat for small mammal species is moderate quality with the low percent of DHC in the stands. Treatments may further degrade habitat for these species, however existing DHC will be retained as much as possible. Coarse woody debris would also be decreased which will impact the pygmy shrew and other small mammal species by degrading habitat conditions. This may also affect the prey base for boreal owls by changing the distribution across the landscape. Design features require the retention of coarse woody debris which will maintain that habitat component in stands after treatments. There will be a decrease in canopy cover and stand density but some areas may still maintain more than one story. Patches of habitat may be lost or degraded with the group selection prescription. Treatments are intended to increase age class diversity and tree species composition making stands more resilient to future bark beetle attacks which will decrease the chances of more habitat loss in the future.
	Between 40 and 90% and ≥35% DHC and advanced regeneration above mean snow depth	• Salvage of dead and dying. • Follow uneven aged management prescriptions in areas where mortality is lower. • Remove live trees that pose a blow down risk. • Maximum removal is 40% of present stocking within residual stand to maintain wind "firmness".	Habitat for all of these species may be degraded or lost as a result of treatment activities. There will be a decrease in canopy cover, stand density, and coarse woody debris with group selection treatments. This may degrade habitat for the pygmy shrew as well as habitat for boreal owl prey species resulting in a decrease in prey availability. Design features will minimize effects to coarse woody debris levels and retain snags across the landscape which will maintain some habitat components for all species. Salvage treatments will likely cause losses of habitat with the removal of canopy cover and stand density. Thermal cover may be affected by treatment activities for the shrew, but it will depend on the remaining understory. However, WFRP – 2,3,4,5,8, 10 and 15 will help ensure retention of habitat for boreal owls, flycatchers and shrews across the broader landscape even though it may be of lower quality due to high overstory tree mortality..
	Between 40 and 90% and <35%DHC	• Salvage of dead and dying. • Follow uneven aged management prescriptions in areas where mortality is lower. • Remove live trees that pose a blow down risk. • Maximum removal is 40% of present stocking within	Habitat for all of these species is low quality and may be degraded or lost as a result of treatment activities. Treatments will remove canopy cover and stand density with salvage activities while other prescriptions will decrease these elements. All activities will lower the amount of coarse woody debris in stands which will affect shrews and small mammals that are prey for boreal owls. Design features will minimize effects to coarse woody debris levels which will maintain some habitat. Decreases and loss of canopy cover and stand density may degrade the quality of habitat for all species and because mortality is between 40% and 90%, stands will likely be left with patches of low quality habitat that may not be large enough to support any of the avian species

Stand Condition	Overstory Mortality Level	Treatment	Effects to Habitat
		residual stand to maintain wind "firmness".	across the landscape. However, WFRP – 2,3,4,5,8, 10 and 15 will help ensure retention of habitat for boreal owls, flycatchers and shrews across the broader landscape even though it may be of lower quality due to high overstory tree mortality..
	>90% ≥35% DHC and advanced regeneration above mean snow depth or >90% and <35%DHC	• If two canopies still alive, it is a multi-storied stand. • Salvage of dead and dying.	These stands are unlikely to support suitable habitat for the boreal owl and nesting habitat for flycatchers except in cases where more than one story exists. Under those conditions, habitat would be low quality due to the amount of mortality in the stand. Canopy cover and stand density would already be low and highly degraded due to the extensive mortality. Flycatcher habitat may be available but it would be marginal at best and likely in patches. Habitat for shrews may still occur if there is a developed understory that can provide food, cover, and shelter. Treatments may further degrade any suitable habitat that remains and it is expected stands would be marginal habitat in patches and in other areas it is unlikely to support any of these species in the immediate future. However, WFRP – 2,3,4,5,8, 10 and 15 will help ensure retention of habitat for boreal owls, flycatchers and shrews across the broader landscape even though it may be of lower quality due to high overstory tree mortality.

Boreal Toad and Northern Leopard Frog

Direct effects to boreal toads and northern leopard frogs include crushing or injuring individuals that may be dispersing across upland areas between aquatic habitats by heavy equipment or by personnel conducting treatments in the area. Winter salvage harvest activities that compact snow have the potential to negatively impact these species by creating barriers to migration, food, and mates. If over-snow activities take place when snow levels are low, there is also the potential for soil compaction and disturbance. If winter salvage activities occur through suitable amphibian habitat, breeding sites could be impacted. In addition, if amphibian hibernation chambers, or winter habitat, were present beneath snow compacted areas, emergence (April–May for leopard frog, May-June for boreal toad) could be delayed because compacted snow melts slower than un-compacted snow and could act as a barrier to movement. Over-the-snow activities will be managed to minimize or avoid riparian and wetland habitats. Aquatic best management practices will provide protection for streams and adjacent riparian areas.

Indirect effects to boreal toad and northern leopard frog habitat are expected to be minimal. The proposed vegetation treatments are expected to have minimal adverse effects on water quality based on treatment prescriptions. Best Management Practices (BMPs) as described by the regionally adopted Watershed Conservation Practices Handbook (US Forest Service, 2006c), will minimize any adverse effects to water quality. Riparian areas will be avoided under all action alternatives, except in cases of crossings for access to treatment units (See WQSP-2, 3A, 3B in Appendix B). The use of design features will assure that riparian wetland and riparian features maintain their function on the landscape.

Hoary Bat

Direct effects to hoary bats include the removal of an occupied roost tree which could result in injury, death or displacement of individuals. If individuals are roosting in the immediate vicinity of the project area they may be disturbed by the noise or vibration caused by heavy equipment, the use of chainsaws and smoke resulting from project activities. This could result in temporary displacement of individuals. Impacts resulting from displacement would be greatest during the maternity and the winter roosting seasons. Roosting habitat may be degraded in the salvage of spruce-fir stands and the proposed project does include a design feature that maintains 90-225 snags/100 acres across the landscape. This design feature will retain some snags maintaining roosting habitat for bats. Under design feature WFRP-8, live trees would also be retained in the salvage stands to the greatest extent practical. The largest diameter snags will be maintained and they will be in clumps where possible.

There may be an increased risk of predation if individuals are displaced and unable to locate suitable alternate roosting habitat. Also, vegetation treatments will modify foraging habitat, however it will not remove or decrease the amount of available foraging habitat. The proposed project will also benefit hoary bats and their habitat in the long term by restoring and improving

resiliency of spruce fir stands against future bark beetle infestations, and promoting regeneration. This will occur through a combination of removing dead and dying trees (salvage harvest) which may reduce wildfire risks in treatment areas, retaining existing live, healthy trees and planting seedlings (reforestation) in areas where stocking levels are not adequate. Retained live trees that reproduce will hopefully result in trees that are more resilient to future bark beetle attacks.

The proposed action will also reduce ground and surface fuels through the removal of dead and dying trees. Prescribed fire treatments such as pile burning will also reduce fuels generated by treatment activities. The reduction of fuels would help to slow the rate of spread of a fire in treated areas compared to existing conditions.

North American Wolverine

The wolverine is included in this analysis because proposed management activities involve suitable habitat that may be occupied. Although occasional sightings of wolverine occur and are reported on the Forest, there had been no confirmed occurrences locally or in Colorado since 1919 until the recent arrival of M56, an individual male who arrived in 2009 from Wyoming and apparently remains in the north-central portion of the state (Colorado Division of Wildlife Website, Species of Concern, Wolverine, 2013). In addition, a wolverine was documented as a traffic-related mortality on Interstate 70 in 2012 within Region 3 of the Colorado Department of Transportation (CDOT 2012b).

In August 2014 (79 FSR 47522), the U.S. Fish and Wildlife Service (FWS) withdrew the proposed rule issues on February 4, 2013 (78 FR 7864) to list the Distinct Population Segment (DPS) of the wolverine that occurs in the contiguous U.S. as a threatened species under the ESA. The FWS also withdrew in August 2014, the associated proposed rule under section 4(d) of the Act to designate wolverine as a nonessential population under section 10(j) of the Act for the Southern Rocky Mountains.

Given that all potential habitat associated with the proposed action is currently unoccupied there will be no direct effect to the species. However, if the species is eventually reintroduced to or recolonizes Colorado, activities such as vegetation management and fuels reduction are not expected to have measureable influences on wolverine habitat because changes in vegetative characteristics has little affect to the species. These activities are also not identified as a potential threat to the species and are included in the proposed Section 4(d) incidental take allowances.

The SBEADMR project will not result in a loss of habitat for wolverines because habitat is not based on vegetative and geologic conditions, but more on the climatic conditions of an area. They have been found to use areas that are cold and receive enough winter precipitation to maintain deep snow late into the warm season in a variety of vegetation and geologic types. Forage conditions for wolverines could be altered as a result of the proposed project because vegetation treatments will result in changes in the types of plant and animal species available in

treated areas. However, this is not likely to negatively impact wolverines because they are opportunistic feeders and consume a variety of fruits, nuts, berries, animals, birds and carrion. It is the availability of forage, not the type that makes up their diet. Therefore, treatments proposed for the SBEADMR project will not affect individual wolverines or their habitat.

American Marten

Direct effects to American marten include noise due to the presence of heavy equipment during treatment activities, and smoke resulting from prescribed fire activities including pile burning and broadcast burning in aspen stands. Noise disturbance and smoke may result in the temporary displacement of martens in the area. Project activities will also remove suitable habitat as a result of salvage harvest and coppice treatments in aspen. Coppice treatments will promote regeneration of aspen stands.

Indirect effects based on silvicultural treatments in spruce-fir stands are summarized in Table 83. Marten are not found in aspen stands so aspen treatments will not affect martens or their habitat.

Table 83. Effects of Silvicultural Treatments to American Marten in Spruce-Fir Stands.

Stand Condition	Overstory Mortality Level	Treatment	Effects to Martens
Single Storied	<40%	• Individual tree selection. • Removal focused on pockets of dead and dying spruce-fir. • Harvest 15-25% of stand. • May require mechanical site prep.	Treatments will slightly alter habitat conditions with decreases to canopy cover, stand density, stand structure, coarse woody debris and understory vegetation. All of these habitat components may reduce habitat, but will not result in a loss of habitat. Open pockets will occur within stands but overall, suitable habitat will continue to exist across the landscape. Through single tree and group selection, regeneration of a spruce understory is likely to occur which will improve long-term habitat conditions for marten.
	Between 40-90%	• Remove all dead and dying spruce-fir in areas where adequate seed source exists. • Group selection where mortality is patchy. • Clear cut where mortality is extensive. • Create small openings in areas where <40% mortality occurs. • Maximum removal is 40% of present stocking within residual stand to maintain wind "firmness". • May require mechanical site prep.	Suitable habitat for marten may be degraded or lost as the level of sanitation and salvage treatments increase with increasing overstory mortality. The use of single tree and group selections in stands with relatively low overstory mortality will result in a slight decrease in canopy cover, stand density, coarse woody debris and snags. This may degrade both denning and foraging habitat. As the level of salvage increases with increasing overstory mortality, marten habitat in treated stands will experience increasing levels of impact. Design features WFRP-2, 3, 4, 5, 8, 10, and 15 will help retain denning and foraging habitat for marten within matrix habitat and across the broader landscape.
	>90%	• Remove all dead and dying spruce-fir where there is no adequate natural seed source. • Clear cut where mortality is extensive. • May require mechanical site prep.	These stands provide low quality to marginal habitat for and treatment activities will further reduce the quality of habitat. Canopy cover, stand density, and coarse woody debris will be decrease in treated stands. Due to the lack of an understory and incidental loss of the understory where it does occur, habitat will be lacking in treated stands These stands will no longer support suitable habitat and it will take years for suitable habitat to regenerate even with planting activities. Design features WFRP-2, 3, 4, 5, 8, 10, and 15 will help retain some denning and foraging habitat for marten within matrix habitat and across the broader landscape where understory components and down wood exists to support marten.

Stand Condition	Overstory Mortality Level	Treatment	Effects to Martens
Two Storied	<40% and ≥35% DHC and advanced regeneration above mean snow depth	• Individual tree selection or group selection in 0.25 to 2 acre openings. • Removal focused on pockets of dead and dying spruce-fir.	Stands currently provide suitable habitat for martens. Treatments will result in open pockets within stands and stand density and canopy cover will decrease in these areas. Stands will continue to provide suitable habitat across the landscape. The availability of forage may change, but mainly in distribution with group selection treatments due to incidental reduction in understory vegetation in these patches. Through single tree and group selection, regeneration of a spruce understory is likely to occur which will improve long-term habitat conditions for marten.
	<40% and <35%DHC	• Individual tree selection or group selection in 0.25 to 2 acre openings. • Remove dead and dying spruce-fir.	Treatments will alter habitat conditions with open pockets occurring in stands as a result of group selection tree removal. Canopy cover, stand density and snags will decrease in these patches, but overall, suitable habitat will remain. Foraging habitat is not high quality due to the low percent of DHC currently in the stands. Treatments may further degrade habitat for marten prey with incidental loss of understory vegetation and decrease in coarse woody debris. Design features for coarse woody debris and snag retention will retain some habitat features maintaining these habitat components in stands after treatments (WFRP 2-5). Through single tree and group selection, regeneration of a spruce understory is likely to occur which will improve long-term habitat conditions for marten.
	Between 40-90% and ≥35% DHC and advanced regeneration above mean snow depth	• Salvage of dead and dying. • Follow uneven aged management prescriptions in areas where mortality is lower. • Remove live trees that pose a blow down risk. • Maximum removal is 40% of present stocking within residual stand to maintain wind "firmness".	Suitable habitat for marten may be degraded or lost as the level of sanitation and salvage treatments increase with increasing overstory mortality. The use of single tree and group selections in stands with relatively low overstory mortality will result in a slight decrease in canopy cover, stand density, coarse woody debris and snags. This may degrade both denning and foraging habitat. As the level of salvage increases with increasing overstory mortality, marten habitat in treated stands will experience increasing levels of impact. Design features WFRP-2, 3, 4, 5, 8, 10, and 15 will help retain denning and foraging habitat for marten within matrix habitat and across the broader landscape.
	Between 40% and 90%	• Salvage of dead and dying. • Follow uneven aged management	Habitat for martens in these stands would already be low quality and may be further degraded or lost as a result of treatment activities. As the level of sanitation and salvage

Stand Condition	Overstory Mortality Level	Treatment	Effects to Martens
	and <35%DHC	prescriptions in areas where mortality is lower. • Remove live trees that pose a blow down risk. • Maximum removal is 40% of present stocking within residual stand to maintain wind "firmness".	treatments increase with increasing overstory mortality. The use of single tree and group selections in stands with relatively low overstory mortality will result in a slight decrease in canopy cover, stand density, coarse woody debris and snags. This may degrade both denning and foraging habitat. As the level of salvage increases with increasing overstory mortality, marten habitat in treated stands will experience increasing levels of impact. Design features WFRP-2, 3, 4, 5, 8, 10, and 15 will help retain denning and foraging habitat for marten within matrix habitat and across the broader landscape.
	>90% and ≥35% DHC and advanced regeneration above mean snow depth or >90% and <35%DHC	• Stand no longer two storied due to dead overstory. • Salvage of dead and dying spruce-fir.	These stands are unlikely to support suitable habitat for martens because of the amount of mortality in the stand. Canopy cover, stand density, and coarse woody debris will be decrease in treated stands. Due to the lack of an understory and incidental loss of the understory where it does occur, habitat will be lacking in treated stands These stands will no longer support suitable habitat and it will take years for suitable habitat to regenerate even with planting activities. Design features WFRP-2, 3, 4, 5, 8, 10, and 15 will help retain some denning and foraging habitat for marten within matrix habitat and across the broader landscape where understory components and down wood exists to support marten.
Multiple Canopies	<40% ≥35% DHC and advanced regeneration above mean snow depth	• Individual tree selection or group selection in 0.25 to 2 acre openings. • Removal focused on pockets of dead and dying spruce-fir.	Treatments will slightly alter habitat conditions for martens and will result in open pockets within stands. Stand density will slightly decrease in some areas, but they will continue to provide suitable habitat across the landscape especially in areas where more than one story remains. Habitat for marten prey will also be affected in patches, but populations are not expected to result in any significant change. Through single tree and group selection, regeneration of a spruce understory is likely to occur which will improve long-term habitat conditions for marten

Stand Condition	Overstory Mortality Level	Treatment	Effects to Martens
	<40% and <35%DHC	• Individual tree selection or group selection in 0.25 to 2 acre openings. • Removal focused on pockets of dead and dying spruce-fir.	Treatments will slightly alter habitat conditions martens. Open pockets will occur as a result of treatments in stands and stand density will slightly decrease. Habitat for marten prey is moderate quality with the low percent of DHC in the stands. Treatments may degrade DHC and decrease coarse woody debris which will affect small mammal habitat. However existing DHC will be retained as much as possible and a design feature will maintain coarse woody debris levels minimizing habitat loss for marten prey. Prey is expected to remain available in stands. There will be a decrease in canopy cover and stand density but some areas may still maintain more than one story. Snags will also be retained at 90-225 per 100 acres. Patches of habitat may be degraded with the group selection prescription. Through single tree and group selection, regeneration of a spruce understory is likely to occur which will improve long-term habitat conditions for marten.
	Between 40 and 90% and ≥35% DHC and advanced regeneration above mean snow depth	• Salvage of dead and dying. • Follow uneven aged management prescriptions in areas where mortality is lower. • Remove live trees that pose a blow down risk. • Maximum removal is 40% of present stocking within residual stand to maintain wind "firmness".	Suitable habitat for marten may be degraded or lost as the level of sanitation and salvage treatments increase with increasing overstory mortality. The use of single tree and group selections in stands with relatively low overstory mortality will result in a slight decrease in canopy cover, stand density, coarse woody debris and snags. This may degrade both denning and foraging habitat. Habitat for marten prey may also be lost or degraded resulting in a decrease in prey availability As the level of salvage increases with increasing overstory mortality, marten habitat in treated stands may experience increasing levels of impact. Design features WFRP-2, 3, 4, 5, 8, 10, and 15 will help retain denning and foraging habitat for marten within matrix habitat and across the broader landscape.
	Between 40 and 90% and <35%DHC	• Salvage of dead and dying. • Follow uneven aged management prescriptions in areas where mortality is lower. • Remove live trees that pose a blow down risk. • Maximum removal is 40% of present stocking within residual stand to maintain wind "firmness".	Habitat for marten is low to moderate quality and may be degraded or lost as a result of treatment activities. Salvage treatments will remove canopy cover and stand density with while other prescriptions will decrease these elements. All activities will lower the amount of coarse woody debris in stands which may degrade habitat for marten prey. Design features will minimize effects to coarse woody debris levels and impacts to DHC will be avoided where possible which will maintain some prey habitat. Martens will be affected with changes in distribution and abundance of prey in stands. Design features WFRP-2, 3, 4, 5, 8, 10, and 15 will help retain denning and foraging habitat for marten within matrix habitat and across the broader landscape.
	>90% ≥35% DHC and	• If two canopies still alive, it is a multi-storied stand. • Salvage of dead and dying.	These stands are unlikely to support suitable habitat for martens except in cases where more than one story remains. Under those conditions, habitat would be marginal quality at best because of the amount of mortality. Canopy cover and stand density would already be

Stand Condition	Overstory Mortality Level	Treatment	Effects to Martens
	advanced regeneration above mean snow depth or >90% and <35%DHC		absent or low and highly degraded. Habitat for marten prey may still occur if there is a developed understory that can provide food, cover, and shelter, thus prey may still remain after treatments. However, treatments may degrade any denning habitat that remains and it is expected only patches of marginal habitat would remain and would not support martens in the in the immediate future. Design features WFRP-2, 3, 4, 5, 8, 10, and 15 will help some retain denning and foraging habitat for marten within matrix habitat and across the broader landscape.

Alternative 3 (Public Safety Focus) – Direct and Indirect Effects on Sensitive Species

Direct and indirect effects for all species analyzed will be the same as described for the Proposed Action. Alternative 3 has fewer opportunity acres considered for treatment, however the maximum amount of acres treated annually and over the life of the project is the same. Treatments would be limited to the WUI and alongside roads (public safety areas), and therefore the extent of potential treatment impacts across the landscape would be more concentrated. There are fewer miles of potential road construction associated with implementing this alternative. With fewer constructed roads, there would be less associated direct loss of understory habitat. Treatment activities proposed for use are the same as described for Alternative 2.

Treatments would be focused in the Wildland Urban Interface to protect adjacent communities and developed areas. Species may inhabit these areas, but likely at lower densities due to the presence of humans and structures. Generally, salvage treatments would have a neutral or negative effects to species analyzed. Resiliency treatments may have short-term negative effects but may benefit multiple species in the long-term. The improved conditions however will not be as widespread as in Alternatives 2 and 4. Alternative 3 will include a lower amount of acres to be treated and fewer potential miles of temporary roads compared to Alternative 2 and 4. Therefore, Alternative 3 is likely to be less impactful to species analyzed in this document.

Alternative 4 (Spruce Salvage) – Direct and Indirect Effects on Sensitive Species

Direct effects to all species analyzed would be the same as described for the proposed action. Both mechanical and non-mechanical methods will be used to implement Alternative 4. The amount of commercial opportunity acres for treatment is higher, but the actual treatment amounts expected to occur annually and over the life of the project is the same. Temporary displacement of species occurring in treatment areas will occur with the use of heavy machinery and the increased presence of personnel and vehicles.

Indirect effects would also be the same as described for the proposed action. Stand structure in spruce would still be altered with the salvage of dead and dying trees and habitat. Benefits of resiliency treatments in spruce to various species would not be realized, relative to Alternatives 2 and 3. The loss of habitat due to the potential construction of roads is expected to be the same because this alternative includes the same maximum potential estimated amount of miles for implementation as the proposed action.

Cumulative Effects Common to All Action Alternatives

Under NEPA, cumulative impacts are 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.

SBEADMR may cumulatively increase impacts to various species on the Forest Service lands when considered with other projects/activities. Disturbance from treatment activities would be

short-term and would be due to the presence of personnel and equipment during project implementation. Vegetation treatments included in the proposed action would alter existing habitat conditions and in some cases, it would reduce the amount of suitable habitat available for some species, while for others there may be no impact, and others would benefit. These effects would last for the medium-term; however the magnitude of the effects would decrease in the long-term.

Vegetation management activities in the past, present and future would continue to affect species and their habitats in both positive and negative ways. The treatment of noxious weeds may impact species in the area, but application rates are at levels that are not expected to result in mortality to individuals. Over the long-term, weed treatments would be likely to improve habitat conditions for wildlife and increase ecosystem resilience. Activities such as grazing, recreation use, road use and maintenance and the presence of private land around the project area would have a continued impact on wildlife in the area. Wildlife species have been disturbed by activities associated with recreation and with road maintenance a regular basis, though recreation use continues to increase. Grazing activities on Forest system lands and on private lands would continue to affect vegetation, soil and water quality in the area and may impact small mammal populations. The proposed project would increase cumulative effects to all species analyzed when combined with these activities, but the impacts are not likely to affect population viability due to the relatively limited extent of acres treated, both within the context of the cover types and the larger landscape.

Determination of Effect and Rationale

Based on this analysis, the action alternatives for SBEADMR project "***May adversely impact individuals, but not likely to result in a loss of viability in the Planning Area, nor cause a trend toward federal listing*** for the northern goshawk, boreal owl, flammulated owl, olive sided flycatcher, boreal toad, northern leopard frog, hoary bat, American marten and pygmy shrew. The rational for this conclusion is based on:

- The maximum acres that would be treated under all action alternatives is limited in extent to 120,000 acres. This represents only 4% of the entire land base of the GMUG National Forests. Further, treatments in spruce-fir and aspen would comprise less than 10% of these vegetation types across the GMUG.
- Design features will minimize effects to several species with timing requirements, and the retention of important habitat elements including snags, downed logs and coarse woody debris and pockets of vegetation for habitat connectivity.
- Active nest sites for goshawks will not be affected by treatment activities. A design feature included in the proposed action does require ongoing raptor surveys to determine where they are occurring and to implement protection measures for any active nest sites.

Management Indicator Species

Affected Environment

Management Indicator Species (MIS) for the GMUG National Forests are identified in the Forest Plan on Table II-15 and II-16, pages II-42 and II-43. A MIS Forest Plan Amendment in 2005 reduced the number of MIS from seventeen to twelve (USDA Forest Service 2005b). The GMUG National Forest has completed Management Indicator Species Assessments for all twelve MIS identified in the MIS Forest Plan Amendment (May 2005) and can be found at: http://www.fs.usda.gov/detail/gmug/landmanagement/resourcemanagement/?cid=stelprdb5199668. These Forest-wide assessments include the rationale for the selection of MIS, information on biology, occurrence and distribution, habitat relationships, suitable habitat on the GMUG, monitoring results, available information on population trend and source references. This project MIS assessment is tiered to the Forest-wide assessments. The following table displays the Forest list of MIS and their relationship to the SBEADMR Project Area. Information for each species is partially adapted from species assessments prepared for the GMUG NF.

Terrestrial MIS potentially affected by the no action and the three action alternatives include: Rocky Mountain Elk, Northern goshawk, American Marten and Red-naped sapsucker since they all use spruce or aspen habitat types during some period of their life history. Northern goshawk and American Marten have been previously addressed in the sensitive species section of the DEIS. Rocky Mountain elk and Red-naped sapsucker are addressed here.

Table 84. MIS in the SBEADMR Project Area

GMUG National Forests **MIS Species List**			
Common Name	**Scientific Name**	**Habitat Association**	**Habitat or species Present Within the Project Analysis Area?**
Rocky Mountain elk	*Cervus elephus*	Early succession spruce-fir, Douglas-fir, lodgepole, aspen, mountain shrub. Also MIS for travel mgmt.	Y
Abert's squirrel	*Sciurus aberti*	Late-succession ponderosa pine	N
American marten	*Martes Americana*	Late-succession spruce-fir, lodgepole pine	Y; addressed in the sensitive species section
Northern goshawk	*Accipiter gentillis*	Late-succession aspen and mixed conifer	Y; addressed in the sensitive species section
Red-naped sapsucker	*Sphyrapicus nuchalis*	Pure Aspen	Y
Merriam's turkey	*Meleagris gallopavo*	Gamble oak, ponderosa pine, and Pinion-Juniper	N

GMUG National Forests MIS Species List			
Common Name	**Scientific Name**	**Habitat Association**	**Habitat or species Present Within the Project Analysis Area?**
Colorado river cutthroat trout	*Oncorhynchus clarki pleuriticus*	Aquatic and riparian habitats	Addressed in the Aquatics section
Rainbow trout	*Oncorhynchus mykiss*	Aquatic and riparian habitats	Addressed in the Aquatics section
Brown trout	*Oncorhynchus trutta*	Aquatic and riparian habitats	Addressed in the Aquatics section
Brook trout	*Salvelinus fontinalis*	Aquatic and riparian habitats	Addressed in the Aquatics section

Rocky Mountain Elk

Population Status and Trend

Elk populations are monitored by Colorado Parks and Wildlife. Annual harvest and census data is used to estimate elk populations within specified geographic areas known as data analysis units (DAUs). Several DAUs overlap the boundaries of the Forest while some occur entirely within the boundary of the Forest. Currently, most elk herds in the state of Colorado are at or near population objectives.

The project area occurs within at least a portion of all nine DAUs across the GMUG NF. Based on population estimates compiled by Colorado Parks and Wildlife from 1980 to 2011, the population for all nine DAUs has fluctuated however population numbers have continued to remain at or near population objectives.

Red-Naped Sapsucker

Population Status and Trend

Populations trends for Red-naped sapsucker in Colorado over the past 40 years as derived from the US Geological Survey's Breeding Bird Survay (BBS) are stable or slightly upward. At the GMUG scale, there are nine BBS routes that have been monitored from 1966 through 2011. The number of years monitored during this time-scale varies from 5 to 38 years. Detection levels for red-naped are relatively low on all routes sampled but are sufficient to indicate a stable or slightly upward trend over the sampling period. The primary habitat of red-naped sapsucker is aspen, which provides high-quality cover and nesting areas.

Alternative 1 (No Action) – Direct, Indirect and Cumulative Effects

Rocky Mountain Elk

There would be no human-induced effects as a result of the No Action alternative.

Rocky Mountain Elk rely on both spruce-fir and aspen habitat types on the GMUG. Spruce-fir is primarily used in the summer for foraging and cover and aspen is used as in both summer and winter for foraging and cover. Cumulative acres affected by aspen decline on the GMUG is at 229,000 with no increase in acres affected expected. Cumulative acres of spruce-fir affected by spruce beetle is 223,000 and the affected acres are expected to increase. The loss of mature spruce and aspen will reduce winter and summer cover for elk but increases in under-story regeneration will result in increased summer foraging habitat in some areas. Within stands affected by aspen decline where regeneration is lacking or poor, the amount of young aspen may decline without active management (Sheppard et al. 2015). However, the loss of overstory spruce due to beetle mortality in stands that also support aspen is expected to increase the amount of aspen in some areas.

Red-Naped Sapsucker

There would be no effects as a result of the No Action alternative.

Aspen decline has stabilized at approximately 229,000 aces on the GMUG but affected stands continue to die with mature over-stories being most affected. Regeneration in affected aspen stands is much lower than what would be expected in healthy stands (Sheppard et al 2015). The lack of active management could reduce the amount of young aspen on the landscape which could affect sapsucker populations over time. However, the loss of overstory spruce due to beetle mortality in stands that also support aspen is expected to increase the amount of aspen in some areas. Active small scale treatment in aspen would continue, authorized by other decisions, but at a much lower level relative to the action alternatives.

Direct, Indirect and Cumulative Effects Common to All Action Alternatives

Rocky Mountain Elk

Effects to elk populations as a result of Alternatives 2, 3 and 4 include noise disturbance due to heavy equipment use for mechanical treatments and the presence of personnel for all treatment types. Smoke associated with prescribed fire treatments will also affect elk herds. Activities may cause elk to displace from the project area. A design feature (WFRP-13) which restricts treatment activities if elk herds are found to be wintering in the project area would minimize effects to elk.

Action alternatives would affect summer and fall habitat and areas used in transition during spring and fall as a result of changes in the structure and composition of vegetation. In forested areas, treatments will remove trees which will reduce the amount of thermal and hiding cover, and in

some cases browse (due to aspen coppice treatments) available for elk. Forage may increase in treatment areas due to the understory being released as a result of reductions in overstory cover. Alternatives 2, 3 and 4 will also improve habitat conditions by restoring and improving resiliency of spruce fir stands against future bark beetle infestations, promoting regeneration in both aspen and spruce-fir stands and lowering the risk of a high intensity fire resulting in a stand replacing fire occurring in the area which will help to protect habitat for elk.

Prescribed fire treatments in aspen stands will temporarily decrease the amount of forage available, however over time, forage quality will improve as grasses and shrubs sprout in response to fire activities.

Alternatives 2, 3 and 4 are not likely to negatively affect population trends of Rocky Mountain elk. All action alternatives will affect the distribution of elk in the area in the short term. The difference in the effects between the proposed action (Alternative 2), the public safety alternative (Alternative 3) and the spruce-fir salvage only alternative (Alternative 4) would be where treatments occur and the focus of treatments (resiliency, WUI or salvage). Road construction under Alternatives 2 and 4 are the same and for Alternative 3, there will be a lower amount of road construction needed for project implementation. All action alternatives are expected to treat the same amount of acres both annually and over the life of the project.

In summary, activities would most likely result in temporary displacement or temporary changes in elk behavioral patterns. This displacement is expected to be short term with elk use returning to the same level or possibly greater level in treatment areas due to an increase in forage quality and quantity. There will be minor increases in temporary road density; fewer disturbances would occur in Alternative 3 due to fewer miles of roads utilized compared to Alternatives 2 and 4.

A cumulative effect across all action alternatives is expected to be similar since the maximum total acres that could be treated is the same (maximum 120,000 acres). There is approximately 2.9 million acres of habitat supporting elk on the GMUG. Of this amount, opportunity acres considered for treatment include 718,000 acres under alternative 2 and 4 and 426,000 acres under alternative 3. Maximum treatment areas under any action alternative are 60,000 acres commercial mechanical and 60,000 acres non-commercial mechanical and prescribed fire. This is approximately 4% of the total elk habitat on the GMUG. Treatments in aspen are designed to increase stand resiliency which has proven to be very success in stands with less than 50% overstory mortality (Sheppard et al 2014). Therefore, resiliency treatments may have a short-term negative affects since mature aspen will be cut but a long-term beneficial effect as aspen is regenerated on the landscape. Resiliency treatments in spruce will increase tree age-class diversity increasing some summer foraging habitat and as stand height increases, increased thermal cover for elk. Recovery (salvage) treatments may increase forbs and grasses providing increase forage habitat. The SBEADMR projects in association with other ongoing actions will have both negative and positive effects to elk depending upon the nature extent of the activity. Design features would minimize impacts to elk and all MIS, and in some cases, help achieve

management objectives for those species. Increased age-class diversity in spruce and aspen would contribute to reduced vulnerability of the stands to insect and disease, as well as other stressors.

Due to the relatively limited extent of acres potentially treated across the GMUG National Forests, no discernible changes in population trends are anticipated at the DAU or Forest level.

Red-Naped Sapsucker

Effects to red-naped sapsucker as a result of Alternatives 2, 3 and 4 include noise disturbance due to treatment activities and the presence of personnel as well as smoke associated with prescribed fire treatments. Activities may cause sapsuckers to temporarily displace from the project area.

All alternatives will affect sapsucker habitat due to changes in the structure and composition of aspen stands.Of the approximately 900,000 acres of habitat (primarily aspen cover type) supporting sapsuckers across the GMUG, opportunity acres within aspen considred for treatment is 289,000 for alternative 2 and 4 and 190,000 for alternative 3. Under all action alternatives, a maximum of 30,000-60,000 acres of aspen would be treated. All treatments are intended to promote regeneration and improve resiliency of stands to SAD. This should help maintain aspen on the landscape and promote the future development of habitat for the red-naped sapsucker. Commercial mechanical, non-commercial mechanical and prescribed fire treatments could occur but due to a limited commercial market for aspen most treatments are expected to be non-commercial or through the use of prescribed fire. Treatments in aspen are designed to increase stand resiliency which has proven to be very success in stands with less than 50% overstory mortality (Sheppard et al 2014). Therefore resiliency treatments may have a short-term negative affects since mature aspen will be cut but a long-term beneficial effect as aspen is regenerated on the landscape.

Other ongoing actions occurring in aspen will continue to have some negative effect to sapsuckers but these effects are expected to be minimal unless they directly affect mature aspen. Design features would minimize impacts to MIS, and in some cases, help achieve management objectives for those species. Increased age-class diversity in spruce and aspen would contribute to reduced vulnerability of the stands to insect and disease, as well as other stressors. Due to the relatively limited extent of acres potentially treated across the GMUG National Forests, no discernible changes to population levels are expected under any action alternative.

Aquatics

Affected Environment

Greenback Cutthroat Trout (GBCT) have Endangered Species Act protection as a Threatened Species. Recent genetic research has resulted in an upheaval of the taxonomic status of several varieties of Cutthroat Trout thought to be native to Colorado (Metcalf et al., 2012). The impact of genetic research could affect the regulatory status of this species; however, at this time

populations of this type of Cutthroat Trout are considered Threatened under provisions of the Endangered Species Act.

There are 24 known Conservation Populations of GBCT on the GMUG. Conservation Populations are those having at least 90% native Cutthroat Trout genes and are monitored intensively by State and Federal management agencies (CRCT Conservation Team 2006). Recent research suggests this variety of Cutthroat Trout was aboriginal in western Colorado (Metcalf et al., 2012) and resource management agencies, led by Colorado Parks and Wildlife, have begun to establish new populations in western Colorado. GBCT occupy relatively high elevation streams and are often isolated from the surrounding watershed by natural or human-made barriers. A qualitative examination of the distribution of GBCT Conservation Populations on the GMUG suggests extant populations are located in areas where human presence is infrequent. Habitat quality and population size varies in occupied streams.

Colorado River Cutthroat Trout (CRCT) is a Sensitive Species in the USFS Region 2. Until recently this variety of Cutthroat Trout was believed to be aboriginal to western Colorado (Metcalf et al., 2012). The ongoing debate as to the "proper" taxonomic classification of several types of Cutthroat Trout native to Colorado does not affect the fact that Colorado Parks and Wildlife and Federal land management agencies manage western Colorado CRCT populations having at least 90% native Cutthroat Trout genes as Conservation Populations. Therefore, CRCT populations are monitored and managed in an identical manner to GBCT populations on GMUG lands.

There are 18 known CRCT Conservation Populations on the GMUG. Most of these populations were created through stocking by the state game management agency, now called Colorado Parks and Wildlife. Today these populations are self-sustaining. Habitat quality and population size varies in occupied water bodies. While not as isolated as extant GBCT populations, CRCT populations tend to be located in areas where human presence is limited: native CRCT populations do not support recreational fisheries as popular as nearby non-native fisheries such as Blue Mesa Reservoir, the San Miguel River, and the Taylor River tailwater.

Common Trout are ubiquitous on the GMUG because they are actively managed by the State of Colorado for recreational purposes. Any activity near perennial streams has the potential to impact Common Trout or their habitat. Timber management associated with the SBEADMR project may take place in close proximity to perennial streams that contain Common Trout. The omnipresence of Common Trout species on the Forest makes it extremely unlikely specific actions or the cumulative effects associated with the SBEADMR project could impact Common Trout at a watershed or Forest scale.

Alternative 1 (No Action) – Direct, Indirect and Cumulative Effects

There are no proposed management activities under Alternative 1. Therefore, no changes to aquatic species would result from the implementation No Action Alternative. The direct and

indirect effects of natural processes in combination with past, ongoing, and future activities could result in cumulative effects to aquatic species.

Direct, Indirect and Cumulative Effects of Alternatives Common to All Action Alternatives

There are a several potential direct effects of timber harvest on aquatic populations and stream habitat. These include mortality due to the operation of equipment in a stream channel, destruction of stream habitat due to the operation of equipment in a stream channel, and fragmentation of stream habitat due to the installation of a road-stream crossing that prevents organism passage.

Potential indirect effects to streams of timber harvest in a watershed include erosion from roads and timber harvest in the riparian area or on surrounding hillslopes, increased stream temperature due to harvest of riparian vegetation.

Past actions are considered part of the environmental baseline. Cumulative effects that could be manifested as SBEADMR is implemented, in conjunction with ongoing and future road maintenance and other vegetation treatments, include additive sedimentation from new roads and harvest activities that occur in watersheds with existing road networks. The additive fragmentation of stream networks would be unlikely with the implementation of the action alternatives, given the associated design features to properly design stream crossings. Stream temperatures may increase because of the combined effects of vegetation harvest in proximity to riparian areas, though design features for treatment layout should minimize or avoid such effects.

Design Features

Design features incumbent to the SBEADMR project preclude harvest-related activities in and very near to stream channels. Therefore, impacts from the effects described above would not occur as SBEADMR is implemented. The following table defines potential effects and lists specific design features that render analysis of the potential impacts moot.

Table 85. Design Features for Aquatics. Excerpt from Appendix B.

Design Feature(s)	Effect	Comments
WQSP-2A	Reduce direct mortality.	
WQSP-2A	Minimize impacts to habitat.	
WQSP-3A; WQSA-3B; WQSP-8A(B)	Minimize fragmentation of stream habitat.	WQSP-3A states that aquatic biologists will participate in the design of road-stream crossings. WQSP-3B states temporary crossings will be removed from streams upon completion.
TSHR-1; TSHR-2; WQSP-5A; WQSP-6; WQSP-7A;	Minimize erosion from surrounding watershed.	At least one member of the Aquatics Team will participate in the planning and implementation of

Design Feature(s)	Effect	Comments
WQSP-8B; MNTG-1		treatment-level harvest activities.
WQSP-2A; MNTG-1	Monitor for increased stream temperature associated with harvest near riparian areas and/or climate change.	The Aquatics Team has the ability to perform long-term stream temperature monitoring to quantify the effect (if any) of harvest near streams on stream temperature.
TSHR-1; WQSP-6; WQSP-7A; WQSP-8A; WQSP-8B; MNTG-1	Minimize erosion.	At least one member of the Aquatics Team will participate in the planning and implementation of treatment-level harvest.

Climate change has the potential to affect aquatic populations by reducing the amount of suitable habitat within their range. If stream temperatures rise such that they are outside the suitable range for growth and reproduction, aquatic biota would be forced to respond by moving to suitable areas (typically upstream in Rocky Mountain watersheds) or potentially be extirpated from previously occupied areas. Research in the Pacific Northwest suggests that climate change is contributing to stream temperature changes that are negatively impacting the suitability of historically occupied stream habitat (Peterson et al., 2013). In the Rocky Mountains, changes to stream habitat are not as well studied or defined.

The GMUG Aquatics Team has been monitoring stream temperature across the Forest since 2010. We use a combination of permanent and seasonally deployed stream temperatures sensors at sites across the Forest. The objective of the monitoring program is to develop predictive stream temperature models for the Forest.

There are two ways stream temperature changes could affect habitat suitability for aquatic biota: elevated short-term (1-7 day) stream temperatures that cause mortality and elevated long-term (30 day) stream temperatures that affect growth, feeding, reproduction, and recruitment. The temperature data we have collected since 2010 allow us to evaluate the potential for climate change to alter the suitability of stream habitat over the next 20-75 years.

Most streams on the GMUG have 30-day average stream temperatures that are on the low end of productive for native Cutthroat Trout. Research suggests feeding, growth, reproduction and recruitment are highest when average stream temperature in the hottest 30 days of the year is between 12 and 18 °C (Roberts et al., 2013). Stream temperature data suggest the majority of mid- to high-elevation perennial streams have 30-day average temperatures on the low end of this range. If we assume climate change will result in a 1 °C increase in average stream temperature per decade it would take several decades for 30-day average stream temperatures to be outside the 12-18 °C window.

With design features in place that preclude activity in the WIZ (Water Influence Zone), it is unlikely that SBEADMR could synergize with climate change and negatively impact stream habitat suitability in the foreseeable future.

Determination of Effects and Rationale

Greenback Cutthroat Trout and Colorado River Cutthroat Trout: 1) design features provide for basic protection of perennial streams and aquatic populations; 2) additional treatment-specific design features will be imposed around perennial streams supporting aquatic populations of recreational or conservation significance; 3) the Aquatics Team will participate in the planning, implementation, and post-treatment monitoring to ensure mistakes that may occur are not repeated throughout SBEADMR project implementation; and 4) stream temperature monitoring and the best available science of stream temperature preferences of native Cutthroat Trout suggest the magnitude of changes to stream temperature across the GMUG is unlikely to negatively affect Conservation Populations for the foreseeable future. *Therefore, I determine the project will have no effect and no impact to Greenback Cutthroat Trout and Colorado River Cutthroat Trout on the GMUG*.

Management Indicator Species: As demonstrated in the Species Assessment, populations of Common Trout on the Grand Mesa, Uncompahgre, and Gunnison National Forests are widely distributed, abundant with multiple age classes represented. While timber harvest associated with the SBEADMR project may occur near fish-bearing streams, design criteria included in the SBEADMR project will minimize the possibility of stream reach, population, or watershed-scale effects to these species. Viability of Common Trout is not a concern and not expected to become a concern through implementation of this project or continued implementation of the Forest Plan. Forest Plan standards for Common Trout will continue to be met.

Recommended Conservation Measures to Avoid, Minimize, or Mitigate Adverse Effects

A member of the Aquatics Team will liaise with Colorado Parks and Wildlife fisheries biologists during the planning of all harvest activities near perennial streams. Prior to implementation the planning team will know 1) if the stream supports an aquatic population of recreational or conservation significance; 2) the nature of any significance attributed to the population; and 3) the identified treatment-specific design features (inherent to all action alternatives) or additional constraints necessary to protect the aquatic population and its habitat.

Inherent to all action alternatives is the design feature WQSP-2A, which defines a 100-foot Water Influence Zone (WIZ) for perennial streams and caps the surface disturbance of the potential ground cover within the WIZ at 20 percent. The design feature also prohibits equipment within stream channels during "fish spawning, incubation, and emergence periods." If harvest activity is planned around a stream that is known or suspected to support a Conservation Population of native Cutthroat Trout the Aquatics Team will recommend a ban on the presence of equipment or harvest activity within the stream channel and WIZ. In some cases, it may be necessary to extend

the ban beyond the 100-foot WIZ. Participation by a member of the Aquatics Team in the planning and lay-out of timber harvest near these streams is critical. Additionally, the Aquatics Team will endeavor to assist the planning team in facilitating the harvest while insuring no negative impacts to the Conservation Population, stream habitat, or the watershed it occupies.

A member of the Aquatics Team will participate in implementation and post-treatment monitoring efforts to ensure that design features successfully prevented or minimized negative impacts to watersheds, stream channels, and aquatic populations. Inherent to all action alternatives is the design feature MNTG-1, which outlines a general framework for treatment monitoring that facilitates real-time learning and response by the teams tasked with planning and implementing specific harvest activities.

Consistency with Forest Plan Direction

This project is consistent with Forest Plan direction.

Social Environment

Cultural

Compliance with Regulatory Direction

The SBEADMR project is designed to be compliant with the National Historic Preservation Act of 1966 (amended in 1976, 1980, and 1992) and all other heritage resource management laws and regulations that support, clarify, or expand on the National Historic Preservation Act. It also complies with Federal Regulations 36 CFR 800 (Protection of Historic Properties), 36 CFR 63(Determination of Eligibility to the National Register of Historic Places, 36 CFR 296(Protection of Archaeological Resources), and Forest Service Manual 2360 (FSM 2360) which provide the basis of specific heritage resource management practices. Several other laws address various aspects of heritage resource management, including NEPA, NFMA, Antiquities Act of 1906, Historic Sites Act of 1935, and the Archaeological Resource Protection Act of1979 as amended in 1988 The National Historic Preservation Act calls for tribal participation in the consultation process (Section 106).

An existing programmatic agreement exists between the Colorado State Historic Preservation Office and the Forest Service. A Section 106 (National Historic Preservation Act, as Amended, [NHPA]) Notification will be initiated under the Colorado National Forests Bark Beetle Programmatic Agreement (PA)[19] for the SBEADMR Project in partial fulfillment of the

[19] Amendment Three for the Programmatic Agreement among the Advisory Council on Historic Preservation, The Colorado State Historic Preservation Office and The USDA Forest Service (Colorado National Forests) Regarding the Implementation of Bark Beetle Management, Hazardous Fuel and Tree Reduction Program and Management of Cultural Resource Programs within Hazardous Tree Environments, 2010 .

requirements of the National Historic Preservation Act, as amended. The Colorado State Historic Preservation Office (SHPO) and the Forest have agreed that the procedures derived from the PA would ensure that there would be no adverse effect and no significant impact to cultural resources from the SBEADMR proposed actions.

Affected Environment

Cultural Resources in this analysis consist of the significant archaeological and historical sites or structures left behind by Native American or Euro-American/other past occupation of an area. Such sites are at least 50 years old and have been determined to be significant and eligible for listing on the National Register (NR) of Historic Places as defined in 36 CFR 60. In general, these sites may be valued either for their association with history, Native American culture, or for their scientific research potential. A variety of identification methods may be used to locate sites in a project area depending on the types of sites that are expected and the field conditions. The Forest consults with the State Office of Archaeology and Historic Preservation to determine NR eligibility of any sites identified in a project area, and consults with Native American tribes to identify traditional cultural places or concerns.

SBEADMR is located on the GMUG National Forest (GMUG), which is comprised of the Gunnison, Grand Mesa, and Uncompahgre National Forests. Generally, prehistoric archaeological evidence suggests human occupation of West-Central Colorado spans at least 10,000 years (Reed and Metcalf 1999). Prehistory in this part of Colorado is subdivided into four broad periods; Paleo-Indian (10,000-7800 years Before Common Era [BCE]), Archaic-Period (ca. 10,000-7,800 BCE), Formative Period (500 BCE-1300 Common Era ([CE]), and Proto-historic Period (1300-1801 CE). The Formative period is not well represented in the upland mountainous environments. These broad temporal periods are often further subdivided but will not be addressed here.

By the time of Euro-American settlement, the Ute Indians already occupied the Area of Potential Effects (APE). The Gunnison NF was home to the Tapegauche Utes, who occupied the Los Pinos Indian Agency from 1869-1875 (O'Rourke 1980: 49-50). The Grand Mesa NF may have been used by a band known as the Grand River Utes (Dees 2004: 17). The Uncompahgre NF area lies within the aboriginal territory of the Yampatika–Uncompahgre Ute Band, which was based in the Uncompahgre River valley (Crum and Keene 2009). In 1828, Antoine Robideau established a trading post east of the Uncompahgre Plateau near the confluence of the Uncompahgre and Gunnison rivers; the fort was burned down by Utes in 1844. Significant Euro-American occupation of the area did not occur until after the Utes in this region were forcibly relocated to Utah in 1881.

Following the removal of the Utes to reservations, the APE historically has seen mainly mining, ranching, settlement/homesteading and logging activity. In the Gunnison NF, mining activity was focused on the Gunnison gold belt between 1870 and 1910, with a peak of activity in Taylor Park and the Tin Cup mining areas from 1870-1890. Other districts, such as Cebolla, Cochetopa and

Elk Mountain(s) Mining Districts had more sporadic production in the early 20th Century (Streufert 1999: 27-34). Some of the notable existing historic mining sites and districts on the GMUG are the Colorado Boy Mine, Mountain King (Red Mountain) Mining Districts and the Dorchester Enterprise. In the Uncompahgre NF, the Ouray and Silverton Mining Districts began production in the 1870s with gold and silver finds at the Mineral Farm mining claim (Colorado Geologic Survey, N.D.). The Grand Mesa NF, while lacking precious metals, was identified as having coal deposits early in the 20th Century (United States Bureau of Mines, 1911). Coal mines were developed earlier adjacent to the Gunnison NF in the Crested Butte and the Somerset area in the 1890s.

The APE was the focus for logging in the 19th Century due to the proximity of timber stands to the growing communities located in and adjacent to what would become the GMUG NF. Initially, logging was non-industrial in scale and relied on horse teams to convey cut timber to small and sometimes portable lumber mills for processing. Industrial-scale and mechanized logging was not established until after World War II. Historic logging operations generally left only temporary sites such as camps, small trash scatters, portable sawmilling locations, and structures that are generally not eligible for the National Register. The industrial-scale lumber mills were generally located on private lands outside the boundaries of the GMUG, such as: Norwood, Sapinero, Montrose and Gunnison. Operations at these mills sites were in steep decline by the 1970s and most had ceased by 1980.

Grazing, historically heavy on the Uncompahgre NF, was also present on the Gunnison and Grand Mesa NFs. These upland environments and their forage and water resources provided valuable summer range for area ranchers and farmers. While devoid of permanent ranch settlements, summer range camps, known colloquially as “cow camps” were established in the early 20th Century in many locations throughout the APE. In addition to the remains of cow camps, one may also encounter various water impoundments, ditches and other forms of water conveyance to deliver upland derived water resources to grazing allotments and ranches just outside the forest boundaries. Certain areas in the APE were heavily homesteaded between 1895 and 1920 by individuals hoping to farm under the Homestead Act of 1862 and subsequent related acts. Many of these farms and land claims failed and the lands were returned to National Forest System land ownership; however, a limited number of historic structures and sites remain on the landscape from that era.

Recreation and tourism was not a major factor in the early historic period, with some notable exceptions, such as Taylor Park on the Gunnison NF. Tourism, now a major industry in the project area, grew slowly during the first half of the 20th Century, but with the economic and population increases following World War II, recreation activities and associated features, such as cabins, campgrounds, roads and trails, grew exponentially. Many of the same sites associated with early recreation are still in use today.

Other cultural resource sites of interest are related to early transportation as well as resource management activities by the Forest Service and other government entities in the early 20th Century. Transportation sites include the Alpine Tunnel, a narrow-gauge railroad tunnel passing through the Continental Divide that was constructed in 1882, and the Trout Lake Trestle, used by the Rio Grande Southern Railroad to carry mail and passengers in hybrid motor vehicle-rail cars (USDA FS, N.D.). Early forest management sites of interest are the Fairview Peak Lookout originally constructed of stone in 1912 on the Gunnison NF; and Fort Peabody on the Uncompahgre NF established in 1904 and manned by the Colorado National Guard to manage labor unrest among unionized miners the San Juan and Telluride mining districts (Ibid.).

The Great Depression ushered in massive government-funded resource management programs and camps associated with the Civilian Conservation Corps (CCC). Some of their handiwork is still in use or part of the GMUG NF's interpreted and restored historic buildings and sites; these include the Cold Springs, Ward Lake on the Gunnison NF, Mesa Lakes Guard Station on Grand Mesa NF, and the Silesca Guard Station on the Uncompahgre NF (Ibid.). The CCC also built or improved many travel routes on the GUMG, such as the Divide Road, Cumberland Pass Road, Land's End Road and other "truck trails".

Expected Types of Cultural Resources

Expected types of cultural resources potentially located within the SBEADMR project area consist of archaeological sites from both the prehistoric, proto-historic and historic periods. Based on previous work in and around SBEADMR, expected prehistoric cultural resources within the project area would include lithic scatters (predominantly quartzite and chert) representing short and long term camps and limited activity sites; lithic procurement areas; and isolated flaked and ground stone materials and hunting blinds. Generally, prehistoric sites in this APE tend to be found in the lower elevation sagebrush and grassy areas, or above timberline in the high elevations; rarely are prehistoric sites found within the mid-elevation, heavily forested areas. Culturally scarred trees (CSTs), Ponderosa pine, have been found in the lower elevations of the valleys where ponderosa pine stands may be found. A great potential for Ute materials exists dating from the 1860s since the first Los Pinos Agency was located near the project area. Such materials might include, tee pee rings, wickiups or other brush structures and artifact scatters that contain Ute and historic period artifacts.

Expected historic cultural resources would include mining prospect sites; homesteads with hay meadows, structures, wells, or ditches; carved aspen trees; cabins; cow camps; refuse scatters; CCC-Era historic guard stations and linear features such as stage roads, trails; and portable sawmill sites. There are also isolated log cabin ruins in the mid-elevation forested areas of the APE of unknown cultural association; most likely they are associated with trapping, fishing or recreation activities.

Direct and Indirect Effects Common to All Alternatives

Cultural resources may be affected in different ways by different kinds of land management actions. Impacts to sites are considered to be significant or "adverse" effects if they alter or destroy the characteristics that made the site significant. Causing damage or loss of artifacts or features, and sometimes significantly changing the setting of the area immediately surrounding a site may also produce adverse impacts. Under Section 106 (NHPA) the Forest consults with the State Office of Archaeology and Historic Preservation to determine effects to cultural resources.

Most Forest Service actions are designed so that any eligible sites are avoided by actions that could impact them; thus treatments have no effect on the sites. The following discussions address hypothetical effects to sites that *had not* been protected through treatment re-design, or to sites that may have escaped identification because of, for instance, very heavy vegetation. Field inventory is effective in identifying sites in most cases and all inventories conform to SHPO standards for site identification. However, if an area selected for treatment is likely to contain certain kinds of significant sites but has environmental conditions that limit the identification of the cultural resources, this information is considered in determining the potential impact of the treatment and the appropriate mitigation and monitoring measures.

Alternative 1 (No Action Alternative) – Direct, Indirect and Cumulative Effects

This alternative is used as a basis for comparing the effects of the Proposed Action and other alternatives. Under the No Action Alternative, cultural resources would continue to largely be subject to natural processes. Buried sites (none were found) would generally remain intact except for whatever natural erosion might be present, and for mixing of the soil due to rodent and insect activity. In mountainous areas where sites are not buried very deeply, rodents and insects can create considerable soil disturbance. In areas where people often visit, surface artifacts and features may be subject to unauthorized collection or vandalism; in this project area there is little concentrated visitor use.

Wildfire, if unchecked by fuel treatment, may burn over parts of this APE and would likely damage or kill the culturally scarred trees (CSTs) which have been determined eligible for the National Register. Such mature ponderosa pines may survive fire (and have survived past fires in the project area) but when growing in thick oak or other brush, with thick duff on their roots, or with ladder fuels introducing fire to their upper crowns, they are often killed in intense fire conditions. Even if they survived, the forest settings around them would be altered and subject to subsequent accelerated erosion and potential introduction of exotic plant species and other changes.

Although surveys conforming to state standards will be conducted during forest management activities, buried archaeological sites can be missed. Under the No Action alternative, these sites would be subjected to an unknown level risk of intensive burning from wildfires but would otherwise be subjected only to natural decomposition. This decomposition includes wickiups

sites, which have a limited number of years to endure based on the fragility of the cut poles in the mountainous environment.

Ongoing management activities authorized under existing and future NEPA employ cultural resource surveys and consultation with SHPA prior to any ground and vegetation disturbing activities and, for the most part, avoid archaeological sites. These management activities include inadvertent discovery design features the same as or similar to those included in design features to minimize damage to sites that were not found during surface surveys.

Direct and Indirect Effects Common to All Action Alternatives

Following the stipulations of the Colorado National Forests Bark Beetle Programmatic Agreement (PA), areas potentially affected by project activities will be surveyed for cultural resources, such as prehistoric and historic archaeological sites and structures known or anticipated from the SBEADMR Project. These cultural resource field surveys will be conducted over the life of the project, as the annual program of work is developed for SBEADMR implementation. Design features derived in part from the PA and developed specifically for SBEADMR will be implemented to assure that cultural resources located within proposed treatments will be avoided and thus protected from direct, indirect and cumulative effects.

SBEADMR proposes a range of vegetative treatments within the APE. These include mechanical treatments, prescribed burning and chainsaw treatments where material could be piled by hand or machine. Potential effects will be addressed below for each of these broad treatment types.

Mechanical Treatment

Ground disturbance to prehistoric and archaeological sites can be caused by mechanical equipment if cultural resources are not avoided by the proposed design features. Mechanized logging equipment and fuels treatment, such as mastication, can be detrimental to surface as well as buried artifact scatters and sites. Impacts vary, but are related to types of timber harvest-yarding systems employed and use of either tractor-based or rubber tire-based equipment. The later typically produce less direct ground impacts due to reduced pressure (lbs./inch^2) on the ground. Tracked vehicles, such as bulldozers, can cause deep rutting, particularly in turning the vehicle during operations. The potential for detrimental impacts is greatest when the soil is wet, or when soil is exposed on steep slopes. The actual extent of detrimental disturbance that occurs depends not only on the inherent soil and site characteristics, but also the weather conditions during operations, as well as contract administration.

In addition, limited road reconstruction and the construction of temporary roads would be performed to access areas slated for mechanical treatment. The existing road network would primarily be used to access the proposed treatments and remove forest products, possibly supplemented with temporary road construction. The impacts to cultural resources related to primary skid trails, log landings, and temporary road construction will be of longer duration given

the typical blading and repeated heavy use that they receive. Those impacts would be eliminated by application of design features, inherent to all action alternatives, to avoid cultural resource site areas.

Prescribed Burning

SBEADMR treatments rely heavily on the application of prescribed fire. The APE contains prehistoric artifacts made mainly of quartzite and chert, which sustain minimal damage from heat derived from prescribed fire applications. However, if conducted on a cultural resource site with high fuel loadings, a very large amount of hot fuel burning directly upon these rock types could shatter, pot lid-fracture, discolor, or even warp or melt them. When present, studies have shown that high damaging heat is generally limited to the upper 5-10 cm of the soil and surface; therefore, buried materials would not be impacted. However, large tree root systems burning below the ground surface can introduce high heat deeply into the soil. This mainly occurs when the roots were dead/dry prior to the burn, such as beneath standing snags or stumps. Large, piled fuels would have the greatest potential to damage artifacts and thin, dispersed fuels the least. Even when some surface artifacts are damaged from burning, many Native American or prehistoric archaeological sites retain their value since most of the deposit is buried, with the majority of significant mountain sites being between 10 and 30 cm deep, but this is not always true. Some sites contain hearths visible on the surface; such features could be physically damaged and any data obtainable from the charcoal, if present, such as carbonized seeds and macrobotanical remains, could be destroyed by reburning. This scenario would be quite rare due to previous natural fires, the weathering of surface cultural resource materials and the relatively long fire return intervals for spruce-fir and aspen stands covered by this analysis (Romme et al, 2006: 24; Sibold et al, 2006: 631-647; Shinneman et al, 2013). Overall, prehistoric sites are not avoided during prescribed burning but are treated to reduce hazard fuel buildup.

Historical and ethnographic sites contain more materials that are damaged by heat—glass, ceramic, wood and bone artifacts and features. Wooden structures, such as cabin remnants, sawmill slab piles, corrals, and wickiups (Native American habitations) would be destroyed by any level of direct burning. Wickiups are a rare and significant type of site. They are usually found in pinyon-juniper stands and mid-elevations. While unknown in the spruce-fir stands and rare in aspen stands, at least two examples of aspen pole wickiups are suspected in the GMUG NF. They are usually found today in remote areas that have not been treated with any kind of vegetation treatment. Wickiups sometimes have artifact scatters and visible hearths, as well as other cut trees, platforms and other features. These structures would be destroyed in a prescribed burn, especially a stand-replacing burn in pinyon-juniper or mountain shrub plant communities.

Concern exists for the protection of Native American/culturally scarred peeled ponderosa pine trees (CSTs). Generally, such trees are mature and do not have low-hanging limbs, but if they did, pruning would not harm them, and they are too large to be thinned pre-commercially. Sanitizing removal of insect-infested or at-risk trees, which may sometimes be part of a thinning

prescription, may apply to some CSTs, in which case analysis must balance the needs of the health of the forest and the need for protecting CSTs and their setting as historical properties. This is a case-by-case consideration. CSTs may need to be identified as "special" to prevent fuel-wood gatherers from cutting them for fire wood. Because wildfire would also damage or destroy CSTs, most fuel treatments to reduce hazardous fuels are compatible with the CST sites; hand thinning/pruning brush and ladder fuels prior to prescribed burning and careful use of fellar-bunchers is an effective method of protecting these cultural properties. It is expected that the majority of such trees would survive prescribed burns and possibly some wildfires, and despite relatively long fire return intervals, most would have survived past fires already.

Design Features Common to Alternatives 2, 3 and 4

Cultural resource surveys will occur prior to treatment implementation. Locations of all known cultural resource sites needing protection will be shown on internal working maps not subject to disclosure and/or identified on the ground so that these areas are avoided and protected during all phases of treatment implementation.

If any new cultural resource sites are discovered during implementation, treatment activities would stop and the GMUG archeologist would be contacted immediately. The archeologist would evaluate the site and determine how the site would be protected.

In evaluating the cultural resource, the Forest Service would follow the procedure set forth in Amendment Three for the Programmatic Agreement among the Advisory Council on Historic Preservation, The Colorado State Historic Preservation Office and The USDA Forest Service.

Activities involving hazardous tree removal, grapple piling, mechanical treatment, skid trails and landing areas: For all cultural resource sites located during the field inventory or previously known, no mechanical treatment will occur **within the site boundary plus a 50 foot buffer around the site**. If treatment is necessary, these sites and the 50 foot buffer will be hand treated to remove hazard trees and accumulated fuel build up, per Stipulation 5.B.b.ii and Stipulation 6.a and 6.b, Standard Treatments for Historic Properties, in the 2010 Programmatic Agreement for Bark Beetle, Hazardous Fuel and Tree Reduction.

The Cultural Resources Design Features derived from the PA will be implemented for Alternatives 2, 3 and 4 (Table 86 and Appendix B).

Table 86. Cultural Resources Design Features.

	Design Feature	Source
CR-1	Cultural resource surveys will occur prior to treatment implementation. All eligible or unevaluated cultural resource sites within a treatment area will be avoided until State Historic Preservation Office consultation may be	2010 Programmatic Agreement for Bark Beetle, Hazardous Fuel and Tree Reduction Programs

	completed.	
CR-2	Discoveries: If any new cultural resource sites are discovered during implementation, treatment activities would stop and the Forest Service archeologist would be contacted immediately. The archaeologist will evaluate the significance of the cultural resource. If potentially significant, within 48 hours of the discovery, the SHPO will be notified of the discovery and consultation will begin to determine an appropriate mitigation measure. The discovery will be protected from further disturbance until any required mitigation is completed. Operations may resume at the discovery site upon receipt of written instructions and authorization by agency officials.	2010 Programmatic Agreement for Bark Beetle, Hazardous Fuel and Tree Reduction Programs
CR-3	For all cultural resource sites located during the field inventory or previously known, no mechanical treatment or ground disturbing activities will occur within the site boundary, including an additional 50 foot buffer around the site. If mechanical treatments are necessary, the site and the 50 foot buffer around the site will be treated by hand to remove hazard trees and accumulated fuel build up.	Stipulation 5.B.b. ii and Stipulation 6.a and6 .b, Standard Treatments for Historic Properties, in the 2010 Programmatic Agreement for Bark Beetle, Hazardous Fuel and Tree Reduction Programs
CR-4	In areas slated for prescribed fire treatment, flammable cultural resource sites or sites with components or features susceptible to heat damage with the APE will be marked on the ground by an archeologist, along with a buffer area of no less than 50 feet, sufficient to prevent fire or heat from affecting components of the site that may contribute to its eligibility to the National Register of Historic Places. In addition, treatments may include fuel-breaks, no-treatment buffers, wrapping, foaming, wetting, blackline, fire line (hand or mechanical), and clearing the cultural resource sites of flammable debris by raking and hand removal. Any fire line that will be ground disturbing will be subjected to an intensive field inventory; if any additional sites, components or features are located, the fire line will be adjusted to avoid these cultural resources.	GMUG's 2013 Prescribed Fire Programmatic Agreement
CR-5	If road construction cannot physically be relocated to avoid a site, and there is the potential for unidentified buried cultural remains, then SHPO consultation will take place and construction activities in the site boundaries would be monitored by an archaeologist.	GMUG's 2013 Prescribed Fire Programmatic Agreement
CR-6	Culturally Scarred Trees (CSTs) will be protected during mechanical treatments and to the extent possible, during underburns. Hand removal of fuels under CSTs will be conducted to the extent possible to reduce the risk of killing them during prescribed burning. However, no measures will be taken to create firelines or physically prevent burning around the CSTs.	GMUG's 2013 Prescribed Fire Programmatic Agreement
CR-7	Monitoring: For treatments where field inventories are not feasible due to visibility concerns prior to treatment implementation, monitoring in the form of a sample inventory for cultural resources will be required post implementation. This monitoring will take place within one year of treatment implementation, with results provided to SHPO. In addition, a sufficient sample of prescribed fire treated areas will be monitored to assess the	GMUG's 2013 Prescribed Fire Programmatic Agreement

	effectiveness of cultural resource protection measures outlined in CR-4 and CR-6 above.	
CR-8	Cultural resource sites that were required to be avoided during treatment implementation will be monitored for effectiveness of the protection measures following project completion.	GMUG's 2013 Prescribed Fire Programmatic Agreement
CR-9	Native American human remains: Any operator carrying out treatments must notify the Forest Service, by telephone, with written confirmation, immediately upon the discovery of human remains or funerary items, discovered on federal land. The Forest Service must then immediately notify appropriate tribes of the find. All treatment activities must stop in the vicinity of the discovery that could adversely affect it, until tribal consultation can be completed and a Plan of Action can be approved and implemented.	NAGRPA regulation 43 CFR 10.4(g)

Alternative 2 (Proposed Action) – Direct and Indirect Effects

All eligible or listed cultural resources will be avoided in the implementation of this alternative. In addition, any sites whose eligibility as not been determined will be avoided or subjected to a formal determination of eligibility if the site is located in proposed treatment areas during implementation.

Prior to treatment implementation, an intensive cultural resource inventory will be conducted. Significant cultural resources that are identified will be avoided prior to project implementation. Adequate buffer zones will be determined by the field office or USFS archaeologist and the sites will be monitored during and after implementation of the treatments to ensure compliance. If avoidance is not possible, other site mitigation measures will be completed prior to any implementation of the project. Successful avoidance of cultural resources negates any direct and indirect effects in this alternative.

Alternative 3 (Public Safety Focus) – Direct and Indirect Effects

All eligible or listed cultural resources will be avoided in the implementation of this alternative. In addition, any sites whose eligibility as not been determined will be avoided or subjected to a formal determination of eligibility if the site is located in proposed treatment areas.

Prior to treatment implementation, an intensive cultural resource inventory will be conducted. Significant cultural resources that are identified will be avoided prior to project implementation. Adequate buffer zones will be determined by the field office or USFS archaeologist and the sites will be monitored during and after implementation of the treatments to ensure compliance. If avoidance is not possible, other site mitigation measures will be completed prior to any

implementation of the project. Successful avoidance of cultural resources negates any direct and indirect effects in this alternative.

Alternative 4 (Spruce Salvage) – Direct and Indirect Effects

All eligible or listed cultural resources will be avoided in the implementation of this alternative. In addition, any sites whose eligibility as not been determined will be avoided or subjected to a formal determination of eligibility if the site is located in proposed treatment areas during implementation.

Prior to treatment implementation, an intensive cultural resource inventory will be conducted. Significant cultural resources that are identified will be avoided prior to project implementation. Adequate buffer zones will be determined by the field office or USFS archaeologist and the sites will be monitored during and after implementation of the treatments to ensure compliance. If avoidance is not possible, other site mitigation measures will be completed prior to any implementation of the project. Successful avoidance of cultural resources negates any direct and indirect effects in this alternative.

Cumulative Effects Common to All Action Alternatives

Past and future actions that include historic grazing regimes, off-road vehicle use and other recreational activities can result in substantial ground disturbance and cause cumulative, long-term, irreversible adverse effects to paleontological and cultural resources. Some of the project area has previously been subject to mechanized logging and some of it has been chained or re-planted with trees. Illegal off-road vehicle use, which is increasing throughout the state, is also accelerating erosion to surface archaeological sites. Over time, fewer archaeological resources will be available to learn about past human lifeways, to study changes in human behavior through time, and to interpret the past to the public.

While it is hard to determine cumulative effects on unidentified archaeological sites, the three action alternatives would not greatly increase cumulative impacts to known cultural resources because all identified sites in the project area will be protected and avoided. Some minor resources, such as historic artifact scatters, could become scarcer due to prescribed fires and mechanical treatments; these features are not generally significant. Implementation of the SBEADMR project will be conducted in accordance to Section 106 of the NHPA under the USFS Programmatic Agreement (2010 Programmatic Agreement for Bark Beetle, Hazardous Fuel and Tree Reduction Programs). Currently, there are no known traditional cultural properties within or adjacent to the project area. Tribal consultation was initiated in September of 2013 to determine any possible locales that have not been previously identified. To date the GMUG has not received any comments or concerns from the tribes.

Economics

Compliance with Regulatory Direction

Multiple statutes, regulations and executive orders identify the general requirement for the application of economic and social evaluation in support of Forest Service planning and decision making. These include, but are not limited to, the Multiple-Use Sustained Yield Act of 1960 (74 Stat. 215: 16 USC 528-531), National Environmental Policy Act of 1969 (83 Stat. 852; 42 USC 4321, 4331-4335, 4341-4347), and the Planning Act of 1974. CEQ regulations for implementing NEPA [40 CFR 1500-1508] do not require a monetary benefit-cost analysis. However, if an agency prepares a financial efficiency analysis, then one must be prepared and displayed for all alternatives [40 CFR 1502.23].

Office of Management and Budget (OMB) Circular A-94 suggests agencies prepare an efficiency analysis as part of project decision-making, using present net value (PNV) as the criterion.

Timber sales are guided by agency direction found in Forest Service Manual (FSM) 2430. Economic efficiency analysis is guided by Forest Service Handbook (FSH) 2409.18. Forest Service Handbook (FSH) 2409.19, Chapter 60 – Stewardship Contracting, provides direction for applying revenues generated from timber sales to achieve restoration and land management activities.

Executive Order 12898 requires federal agencies to identify and address any adverse human health and environmental effects of agency programs that disproportionately impact minority and low-income populations. The Order also directs agencies to consider patterns of subsistence hunting and fishing when an agency action may affect fish or wildlife.

Analysis Methodology

Indicators used in the analysis of economic effects include Present Net Value (PNV) in the financial efficiency analysis and jobs and labor income in the economic impact analysis. Maximum values were used for the inputs for the analysis (such as acres burned and timber harvested), costs of treatment and revenue. Since the costs are likely more variable, the PNV could potentially overstate the costs.

Non-market values, such as the value of recreation experiences and ecosystem services, are difficult to quantify. Direction provided in 40 CFR 1502.23 and Forest Service Handbook 1909.15 (7/6/04) and 22.35 (01/14/05) provides for the use of qualitative analysis to evaluate the effects of these non-market values. Since proposed activities are anticipated to improve current resource conditions, these activities are highly likely to increase non-market values (benefits) associated with the natural resources within the SBEADMR project area. Since these non-market benefits are not included in the PNV, the PNV is likely an underestimate.

Financial Efficiency (PNV)

Financial efficiency is a comparison of the costs and benefits that can be quantified in terms of actual dollars spent or received in the analysis area over the life of the project. As the Forest Service Handbook 2409.18 indicates, this analysis provides a comparison of anticipated costs and revenues that are part of Forest Service monetary transactions. Given the information provided, financial efficiency measures are calculated in this analysis to provide a means of comparing the financial efficiency of alternatives. This analysis offers a consistent measure for comparison of alternatives, however, it should not be viewed as a complete answer, but as only an examination of trade-offs between costs and benefits.

The alternatives are compared using a financial efficiency measure called Present Net Value (PNV). The foundation behind the PNV calculations is the "Time Value of Money Principle," which states that money received now is worth more than some amount received in the future. A 4-percent discount rate is commonly used for evaluations of long-term investments and operations in land and resource management by the Forest Service (FSM 1971.21). This discount rate is used in the calculation of PNV. A positive PNV suggests the discounted sum of benefits is greater than the discounted sum of costs, and a negative PNV suggests the opposite.

The financial efficiency analysis is specific to the timber harvest and ecosystem management associated with the project (as directed in Forest Service Manual 2400–Timber Management and guidance found in the Forest Service Handbook 2409.18).

Costs that were not included in the stumpage rate, such as sale preparation, sale administration, regeneration, and weed spraying are included in the PNV calculations. The road implementation costs are built into the stumpage rate. The average stumpage rate for the area ($20 per CCF) was used to calculate revenue from the timber harvest per alternative. This stumpage rate was estimated from average bids over the past few years and is based on spruce harvest. The expected revenue is the stumpage rate of $20 per CCF multiplied by the amount of timber harvested. The actual timber value will depend on the market when the timber is sold, and may be higher or lower than this stumpage rate.

This analysis is not intended to be a comprehensive benefit-cost or PNV analysis that incorporates a monetary expression of all known market and non-market benefits and costs that is generally used when financial efficiency is the sole or primary criterion upon which a decision is made. Forest management is expected to yield positive benefits, but not necessarily financial benefits.

Regional Economic Impact Analysis

The economic impacts to the local economy affected by the proposed treatments are measured by estimating the employment (full- and part-time jobs) and labor income generated by (1) the processing of the timber volume from the project, and (2) the dollars resulting from restoration activities. The direct employment and labor income benefit employees and their families and,

therefore, directly affect the local economy. Additional indirect and induced multiplier effects (ripple effects) are generated by the direct activities. The total economic impact of restoration activities includes the direct, indirect, and induced effects and is measured through response coefficients[20] unique to the SBEADMR project analysis area. More information on how the economic impact was calculated can be found in the specialist report located in the project record.

The impacts on the analysis area were calculated based on SBEADMR activities that are expected to be carried out by contractors. If the work is completed by Forest Service staff, then the impacts were assumed to already be considered in the Forest Plan. For example, some road work activities are expected to be carried out by contractors, thereforethese actions would directly impact jobs and labor income in that sector and were not previously analyzed.

The discussion of potential jobs and income impacts should occur alongside consideration of non-market values and financial efficiency. Changes in final demand for goods and services provided by the GMUG National Forest can contribute to employment and income in the area. However, if demand exists for these products, employment and income would likely still be provided, even if these goods and services were not provided by the GMUG. Therefore it is important to consider the efficiency of using these resources alongside potential job and income generation from their use.

Treatment Estimates

The annual estimates below are expected to be implemented over an approximately 8-12 year implementation timeframe. Cumulative totals are the maximum number of treatment acres and harvested volume, or CCF, analyzed in this DEIS. While the project is not constrained to a 10 year timeframe, this period is used for purposes of estimating costs and benefits over time.

Not all of the costs are included in the economic impacts analysis because if the activities are expected to be carried out by Forest Service staff, these costs were already analyzed in the Forest Plan. *Contracted costs* are used to analyze economic impacts to employment and labor income.

However, all of the costs are used in the *financial efficiency analysis* to be able to compare costs to benefits of the proposed activities. Road costs are already incorporated in the stumpage rate of $20/ccf, so it would be redundant to include them as additional line items in the financial efficiency/PNV analysis. However, because some of the road activities would be carried out by contractors, and these contractors would receive associated labor dollars, such road activities are included in the *economic impact analysis*.

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[20] Response coefficients are rates of response of the local economy to each dollar spent by the Forest Service or by users of National Forest resources (i.e. recreation visitors) in private sector businesses. These are generated using IMPLAN software.

This report assumes that the resiliency harvest volume is 10 ccf per acre (2,100 acres * 10 ccf per acre to get total resiliency harvest volume of 21,000 ccf) and salvage harvest volume is 20 ccf per acre (3,900 acres * 20 ccf per acre to get total salvage harvest volume of 78,000 ccf).

Treatment costs within the Wildland Urban Interface (WUI) are expected to be greater than costs outside of the WUI. This is reflected in the sale preparation costs in Table 87 ($647 per acre for WUI sale preparation treatments and $347 per acre for non-WUI sale preparation treatments). This increased cost for WUI treatments is due to such activities as the temporary closure of roads and hazard tree removal. For the Proposed Action only, WUI treatments are assumed to be the salvage acres and non-WUI treatments are resiliency acres.

Table 87. Annual Treatment Estimates and Cost per Alternative.

ANNUAL TREATMENTS					
COST CATEGORY	**Alt. 2 units**	**Alt. 3 units**	**Alt. 4 units**	**Price per unit**	**Unit**
NON-COMMERCIAL ACTIVITIES[21]					
PRESCRIBED FIRE					
Broadcast Burning Maximum (WUI)	2,500	3,500	2,500	$ 125	acre
Broadcast Burning Maximum (Non-WUI)	2,500	0	2,500	$90	acre
Pile Burning[22]	900	700	1,200	$30	acre
MECHANICAL					
Mastication (WUI)	500	2,500	500	$600	acre
Mastication (Non-WUI)	500	0	500	$500	acre
Contract Administration[23]	750	1,500	750	$25	acre
COMMERCIAL ACTIVITIES					
TIMBER HARVEST REVENUE					

[21] Total noncommercial acres per year are anticipated to be approximately 6,000 acres. This total can be derived for each alternative via summing broadcast burning in the WUI and non-WUI and mechanical mastication in the WUI and non-WUI.

[22] Pile burns are applied to a subset of the noncommercial mechanical acres.

[23] Only a subset of the noncommercial mechanical acres would be administered under contract.

ANNUAL TREATMENTS					
COST CATEGORY	**Alt. 2 units**	**Alt. 3 units**	**Alt. 4 units**	**Price per unit**	**Unit**
NON-COMMERCIAL ACTIVITIES[21]					
Resiliency Timber Volume	21,000[24]	10,000	0	$20	ccf
Salvage Timber Volume	78,000[25]	100,000	120,000	$20	ccf
TIMBER HARVEST - COSTS					
Weed Spraying	180	180	180	$205	acre
Sale Preparation: WUI	3,900[26]	5,000	3,000[27]	$647	acre
Sale Preparation: Non-WUI	2,100[28]	1,000	3,000	$347	acre
Sale Administration	4,500	4,500	4,500	$25	acre
Site Preparation	2,400	500	2,400	$152	acre
Planting	2,400	500	2,400	$400	acre
Regeneration Surveys	3,600	5,500	3,600	$25	acre
Plantation Survival Exams	2,400	500	2,400	$17	acre
ROADS					
Surface Replacement Collections	420,000	420,000	420,000	$2	ccf-mile

[24] Volume generated via the following equation: 2100 resiliency acres * 10 ccf/acre = 21,000 ccf. The number of resiliency acres is derived from the assumptions regarding 80% salvage/20% resiliency in the Gunnison Basin and 50% resiliency/50% salvage outside the Gunnison Basin. Assumed 50% of proposed treatments would occur in the Gunnison Basin, and 50% would occur outside of the Gunnison Basin.

[25] Volume generated via the following equation: 3900 salvage acres * 20 ccf/acre = 78,000 ccf. The number of salvage acres is derived from the assumptions regarding 80% salvage/20% resiliency in the Gunnison Basin and 50% resiliency/50% salvage outside the Gunnison Basin. Assumed 50% of proposed treatments would occur in the Gunnison Basin, and 50% would occur outside of the Gunnison Basin.

[26] Acres generated via the assumption that WUI treatments in Alternative 2 would consist primarily of salvage/recovery treatments.

[27] Acres generated via the assumption that the distribution of WUI vs. non-WUI treatments in Alternative 4 would be approximately 50%/50%.

[28] Acres generated via the assumption that treatments outside of the WUI in Alternative 2 would consist primarily of resiliency treatments.

ANNUAL TREATMENTS					
COST CATEGORY	**Alt. 2 units**	**Alt. 3 units**	**Alt. 4 units**	**Price per unit**	**Unit**
NON-COMMERCIAL ACTIVITIES[21]					
Designed Road Construction	6	1	6	$57,090	mile
Temp Road Construction	26	7	26	$9,750	mile
Road Reconstruction	26	26	26	$20,900	mile
Road Maintenance					
Operational Maintenance Level 1	1	1	1	$6,000	mile
Operational Maintenance Level 2	8	9	8	$4,000	mile
Operational Maintenance Level 3	23	35	23	$4,500	mile
Operational Maintenance Level 4	12	18	12	$5,750	Mile
Operational Maintenance Level 5	0	1	0	$1,750	Mile

Affected Environment

The GMUG lies within Delta, Garfield, Gunnison, Hinsdale, Mesa, Montrose, Ouray, Saguache, San Juan, and San Miguel counties. However, the SBEADMR project area is expected to impact a wider region based on the location of commercial harvesting and processing. The analysis area was chosen based on the location of contractors for processing forest products and materials from the GMUG forests. In addition to the GMUG counties listed above, the area with economic impacts from this project includes Archuleta, Chaffee, Dolores, Eagle, Fremont, La Plata, Lake, Mineral, Montezuma, Pitkin, Rio Grande, and Summit counties. The area's social and economic characteristics are dependent on the extent of the area examined, thus area information is presented for the potentially affected 22-county region.

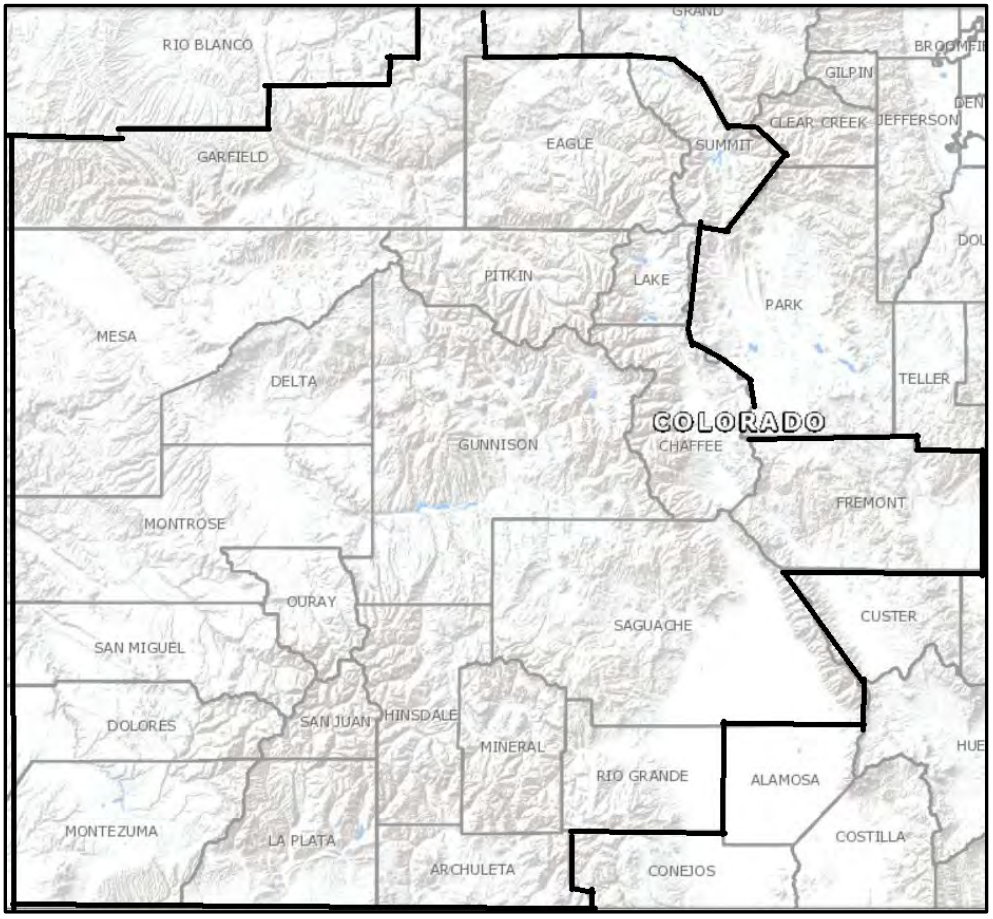

Figure 42. Map of SBEADMR economic analysis area

Population and Demographic Change

From 2000 to 2012, the population of the 22-county analysis area grew from 495,904 to 581,853, a 17.3 percent increase. The growth seen in the analysis area exceeded the national growth rate and Colorado's (9.8 and 17.2 percent, respectively). San Juan County had the largest change in

population, a 34 percent increase. Mineral County had the greatest decrease in population, a 16 percent change (U.S. Department of Commerce 2013).

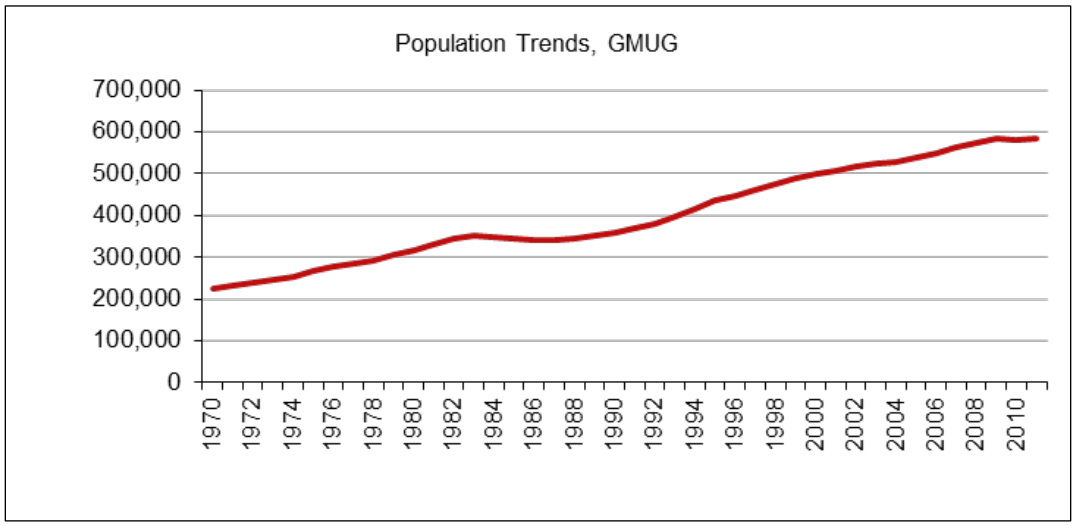

Figure 43. Population change in the 22-county analysis area between 1970 and 2010 (U.S. Department of Commerce 2013b).

Employment

From 2001 to 2013, total private employment in the 22-county analysis area increased from about 294,000 to 332,000 jobs, a 13 percent increase (U.S. Department of Commerce 2013b). Much of this growth is attributable to employment in services-related sectors shown in Figure 44, where total employment in the analysis area is disaggregated into three industry groupings: services-related sectors, non-services related sectors, and government. Services-related sectors consist of the following sectors: Utilities, Wholesale Trade, Retail Trade, Transportation and Warehousing Information, Finance and Insurance, Real Estate and Rental and Leasing, Professional, Scientific, and Tech., Mgmt. of Companies and Enterprises, Administrative and Support Services, Educational Services, Health Care and Social Assistance, Arts, Entertainment, and Recreation, Accommodation and Food Services, and Other Services. Non-services related sectors consist of the following sectors: Mining, Construction, Manufacturing, and Agriculture, Forestry, Fishing, and Hunting (EPS-HDT 2012).

For total private employment, from 2001 to 2011, employment in services-related sectors increased from 76 percent to 80 percent while employment in the non-services related sectors decreased from 24 percent to 20 percent (U.S. Department of Commerce 2013b). Thus the services-related sectors have historically been an important part of the area economy and have increased in importance.

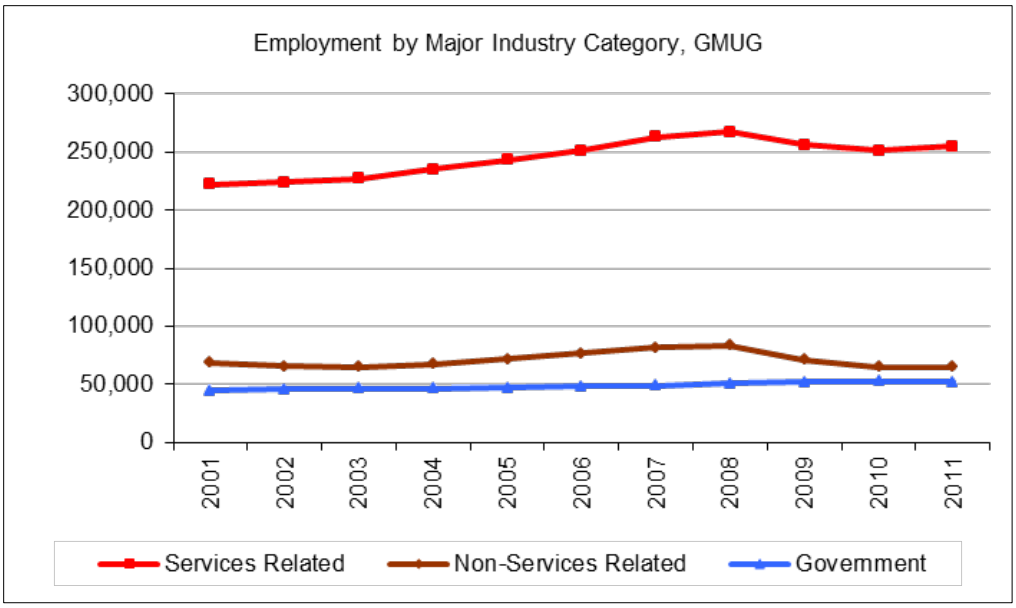

Figure 44. Services and Non-Services employment history (U.S. Department of Commerce 2013b).

Employment specialization within the 22-county analysis area is distributed amongst industry sectors and displayed below in Figure 45 (IMPLAN 2012).[29] Identification of employment specialization for the analysis area provides a frame of reference for effects from changes in management from the SBEADMR project. Specialization is examined using the ratio of the percent employment in each industry in the region of interest (22-county analysis area) to the percent of employment in that industry for a larger reference region (the state of Colorado). For a given industry, when the percent employment in the analysis region is greater than in the reference region, local employment specialization exists in that industry (USDA Forest Service 1998). Of particular interest is where specialization occurs within industries related to SBEADMR management, such as forest products. The potential impacts on the electric power generation, transmission, and distribution are also important to consider if the salvaged wood is used for energy production in the region. It should be noted that the contributions from the SBEADMR project represent only a portion of the economic activity reflected in industry sectors seen in Figure 45.

[29] The numbers in Figure 44 are not directly comparable to the IMPLAN numbers in Figure 45 since IMPLAN data include government, farm and proprietor employment in addition to wage and salary employment. The IMPLAN data also includes estimates for non-disclosures that similarly include farm and proprietor employment in addition to wage and salary employment.

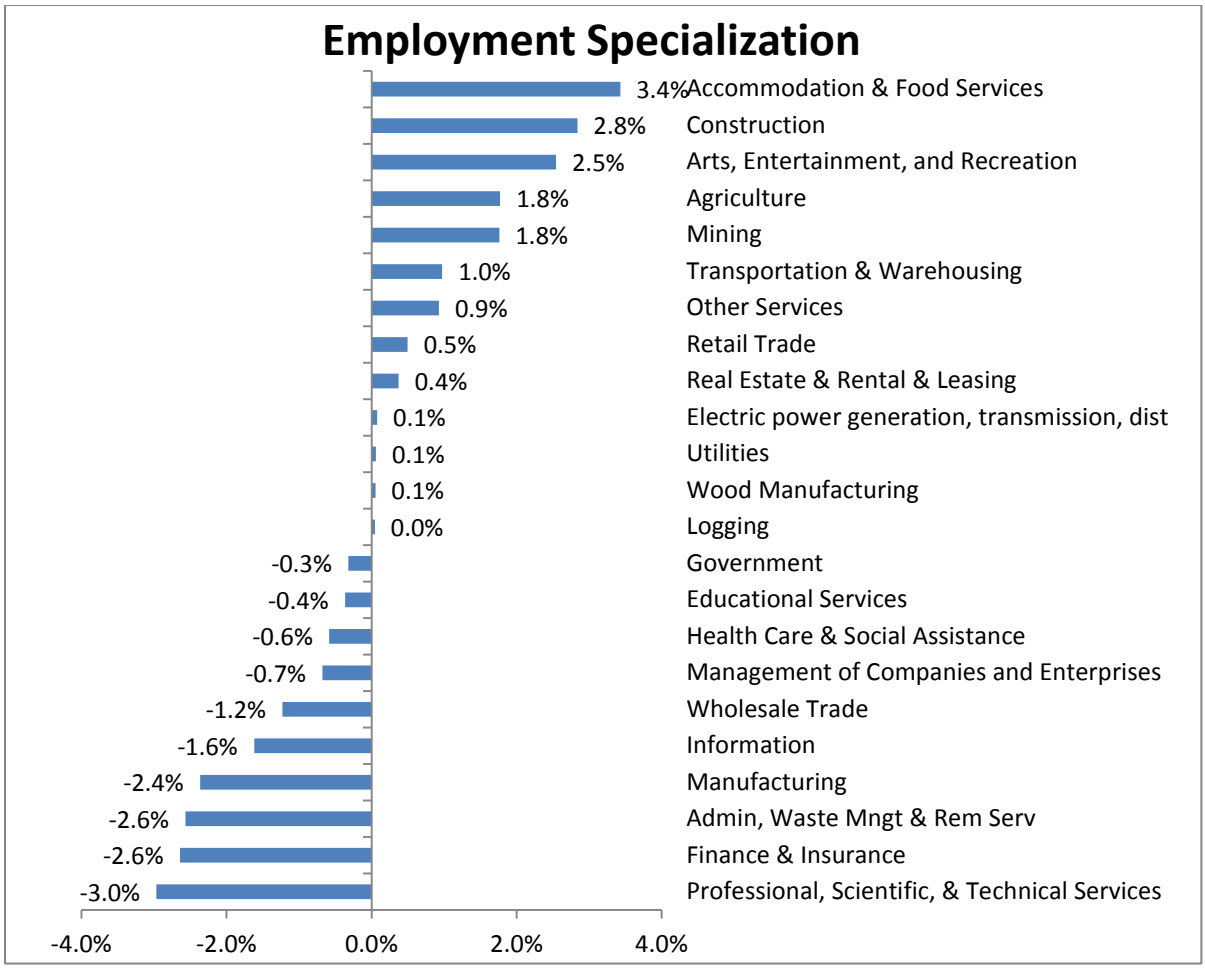

Figure 45. Analysis area employment specialization (IMPLAN 2012).

Using this method to determine specialization applied with 2012 data, the analysis area can be characterized as most specialized in the Accommodation and Food Services, Construction, and Arts, Entertainment, and Recreation sectors, and slightly specialized in the Electric power generation and Logging sectors since the percent of total employment in the analysis area is 0.1 percent greater than in the state of Colorado (IMPLAN 2012). As Figure 46 illustrates, 46 percent of logging jobs in the state are in the 22-county analysis area, 17 percent of wood manufacturing jobs in the state are located in the analysis area and 16 percent of the electric power jobs in the state are in the analysis area.

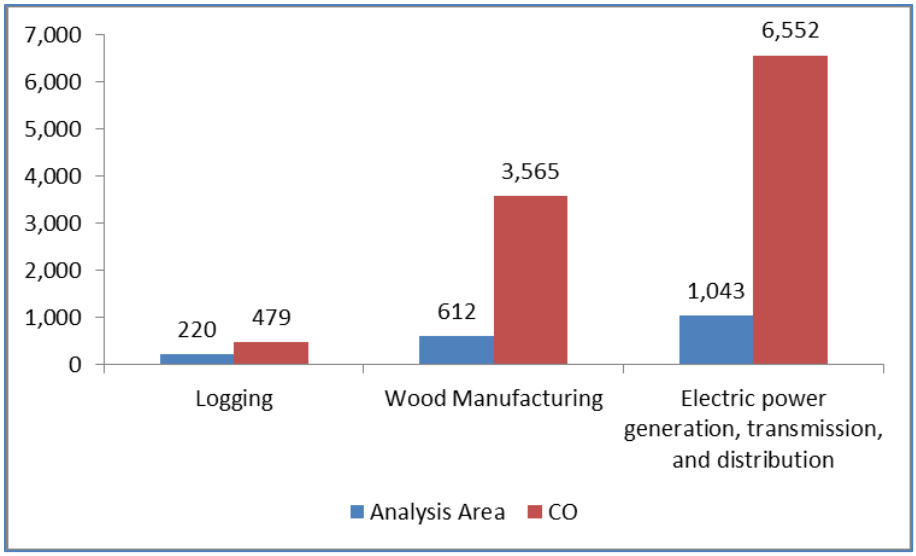

Figure 46. Employment in sectors related to SBEADMR management (IMPLAN 2012).

Economic Well-Being and Unemployment

While the services-related sectors have increased, in general, the service-related sectors do not pay as much as the non-services sectors, thus increases in the percent of total employment attributable to these sectors could decrease area economic well-being. Within the analysis area, the services and non-services related sectors paid average annual wages of $34,911 and $51,240, respectively, in 2012 inflated to 2013 dollars (U.S. Department of Labor 2013). Thus, increases in employment in sectors associated with lower wages alongside decreases in sectors associated with higher wages could indicate a decrease in area economic well-being. However, some people might move to the area and take a lower paying services-related sector job in exchange for the opportunity to experience unique natural and cultural amenities. Population and employment changes are related to natural amenities (Mueser 1995, Lewis 2002) often provided by public lands. The GMUG operates as a steward of many of these natural amenities and consequently supports a portion of area population and employment growth.

Total personal income (TPI) and per capita personal income (PCPI) are useful measures of economic well-being. From 2000 to 2013, annual TPI in the economic analysis area increased from $19 billion to $23.9 billion, and annual PCPI increased from $38,023 to $40,648 (all measures adjusted for inflation to 2013 dollars). This translates to a TPI increase of 26 percent and a PCPI increase of 6.9 percent over this time period (US Department of Commerce 2013b).

While PCPI is a useful measure of economic well-being, it should be examined alongside changes in real earnings per job. Since PCPI includes income from 401(k) plans as well as other non-labor income sources like transfer payments, dividends, and rent, it is possible for per capita income to rise, even if the average wage per job declines over time. Compared to the state of Colorado, the average earnings per job and PCPI in the analysis area ($39,824 average earnings per job and

$40,648 PCPI) were much lower in 2013 than for the state ($54,554 average earnings per job and $46,897 PCPI) (US Department of Commerce 2013b).

From 2000 to 2012, average annual unemployment rates in the analysis area increased alongside national and state rates from 3.2 to 8.5 percent. Starting in 2007, unemployment followed state and national trends and rose to 9.6 percent in 2010 and then began to decline (US Department of Labor 2013).

Components of Personal Income

Further examining trends within personal income provides insight to the area economy and its connection to the GMUG lands. There are three major sources of personal income: (1) labor earnings or income from the workplace, (2) investment income, or income received by individuals in the form of rent, dividends, or interest earnings, and (3) transfer payment income or income received as Social Security, retirement and disability income or Medicare and Medicaid payments.

Labor earnings were the largest source of income in the analysis area accounting for 58.9 percent of all income in 2012 (U.S. Department of Commerce 2013b). Labor earning's share of TPI has decreased from 1970 to 2012 (from 71.6 to 58.9 percent) while the share of non-labor income has risen (from 28.4 to 41.1 percent). As a share of TPI, investment income and transfer payments rose from 16.8 to 25.7 and 11.6 to 15.5 percent, respectively, over this 40-year time period (U.S. Department of Commerce 2013b).

These patterns reflect the importance of the aging population, who are more likely to have investment earnings than younger adults. As the population of the area continues to age, the share of income from these non-labor sources should continue to rise as long as residents continue to stay in the area after retirement or new retirees move in. As noted above, the development of rural recreation and retirement-destination areas are related to natural amenities (Mueser 1995, Lewis 2002) often provided by public lands. The GMUG operates as a steward of many of these natural amenities and consequently supports a portion of non-labor income.

Using the specialization criterion applied with 2012 data, the analysis area can be characterized as most specialized in the Accommodation and Food Services, Transportation and Warehousing, and Construction sectors (shares of total labor income in these sectors are, respectively, 3.7, 3.5 and 3 percent greater than shares in the state, as seen in Figure 47 below). The 22-county area can also be considered slightly specialized with respect to the Electric power generation sector since the percent of total labor income in the analysis area is 0.1 percent greater than in the state of Colorado (IMPLAN 2012).

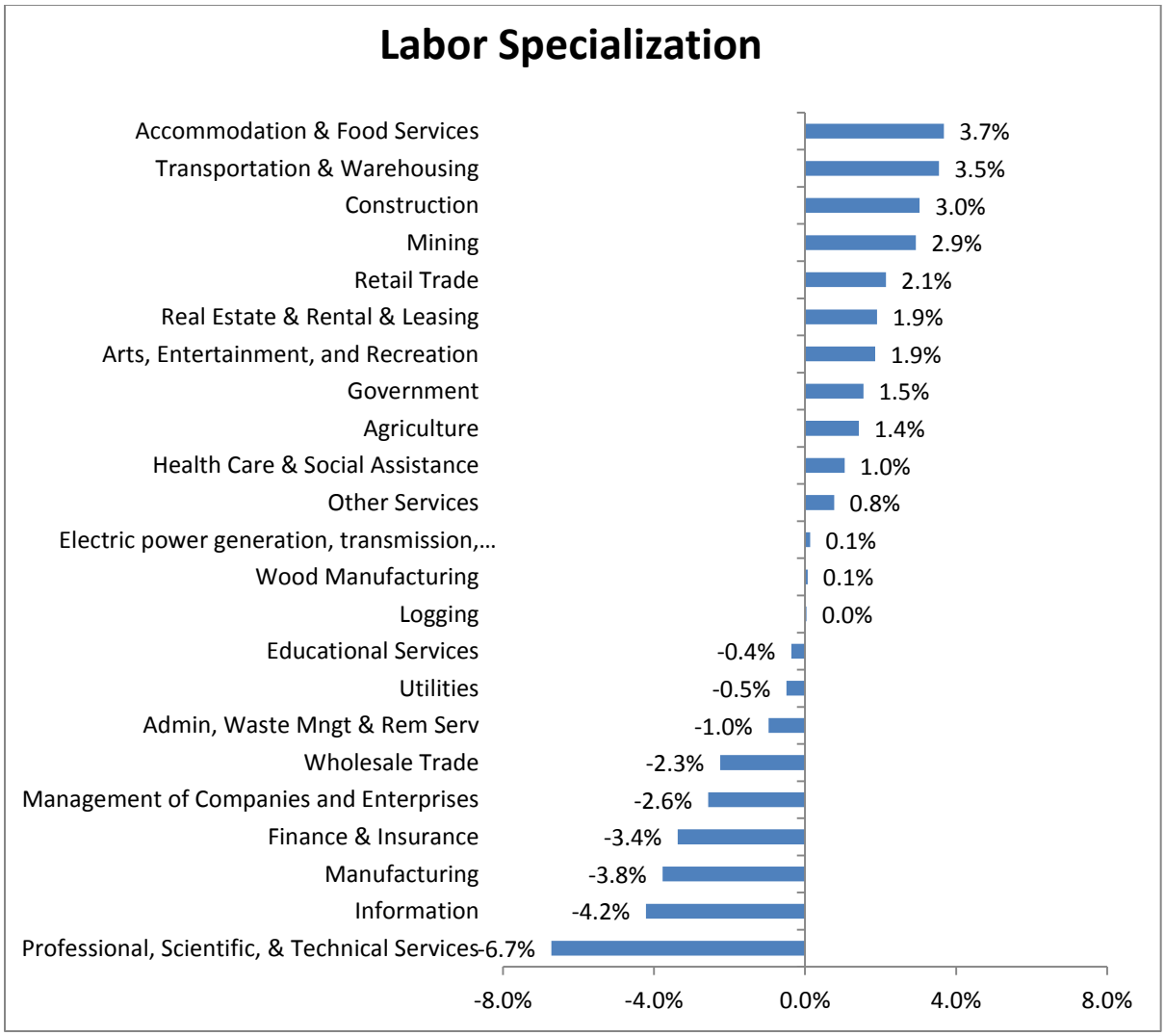

Figure 47. Analysis area labor income distribution and specialization (IMPLAN 2012).

Environmental Justice

Executive Order 12898 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." In order to make this determination, "Agencies should consider the composition of the affected area, to determine whether minority populations, low-income populations, or Indian tribes are present in the area affected by the proposed action, and if so whether there may be disproportionately high and adverse human health or environmental effects on minority populations, low-income populations, or Indian tribes."

The emphasis of environmental justice is on health effects and/or the benefits of a healthy environment. The CEQ has interpreted health effects with a broad definition: "Such effects may

include ecological, cultural, human health, economic or social impacts on minority communities, low-income communities or Indian Tribes …when those impacts are interrelated to impacts on the natural or physical environment" (CEQ 1997).

Race and Ethnicity

According to CEQ (1997) guidance, "minority populations should be identified where either: (a) the minority population of the affected area exceeds 50 percent or (b) the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis."

Colorado's population is predominately white and significantly less diverse than the general U.S. populations. However,

Table 88 indicates that the 22-county region's share of those identifying themselves as American Indian and Alaska Native was higher than the Colorado and U.S. levels, but not by a meaningfully greater amount (U.S. Department of Commerce 2013). Montezuma County was estimated to have the highest percent of those identifying themselves as American Indian and Alaska Native, 11.2 percent (U.S. Department Of Commerce 2013). Rio Grande, Saguache and Lake counties reported the highest percent of individuals that identified themselves as Hispanic (42.8, 41.3, and 34.2 percent of total population, respectively). Therefore, minority populations appear to exist in Montezuma, Rio Grande, Saguache, and Lake counties and potential effects from the alternatives to these groups will be discussed below.

Table 88. Racial and Hispanic Composition of 2012 Population in the 22-County Analysis Area (U.S. Department Of Commerce 2013).

Location	White Alone	Black or African American Alone	American Indian and Alaska Native Alone	Asian Alone	Native Hawaiian and Other Pacific Islander Alone	Some Other Race Alone	Two Or More Races	Hispanic or Latino Origin
United States	63.7%	12.2%	0.7%	4.8%	0.2%	0.2%	2.0%	16.4%
Colorado	70%	3.8%	0.6%	2.7%	0.1%	0.2%	2.1%	20.6%
County Region	78.2%	1.0%	1.4%	0.7%	0.1%	0.2%	1.4 %	17.1%

Poverty

Poverty is an important indicator of both economic and social well-being. Individuals with low incomes are more vulnerable to a number of hardships which may negatively affect their health, cognitive development, emotional well-being, school achievement and which may promote socially unacceptable behavior (Hopson 2011). In general, low-income individuals tend to rely more heavily on natural resources and depend more directly on NFS lands for sustenance and

home heating. Since these individuals will be more vulnerable to changes in the management of local resources, it is important for forest management to understand how these forest users may be affected by restricting forest uses. The Census Bureau uses a set of income thresholds to determine poverty levels.

According to the CEQ (1997) guidance, "low-income populations in an affected area should be identified with the annual statistical poverty thresholds from the Bureau of the Census' Current Population Reports." As seen in Figure 48, the SBEADMR analysis area has the same poverty levels as Colorado and lower poverty rates than the U.S. However, Saguache County has far higher poverty levels than the state and country and likely meets the CEQ's Environmental Justice criterion for low-income populations.

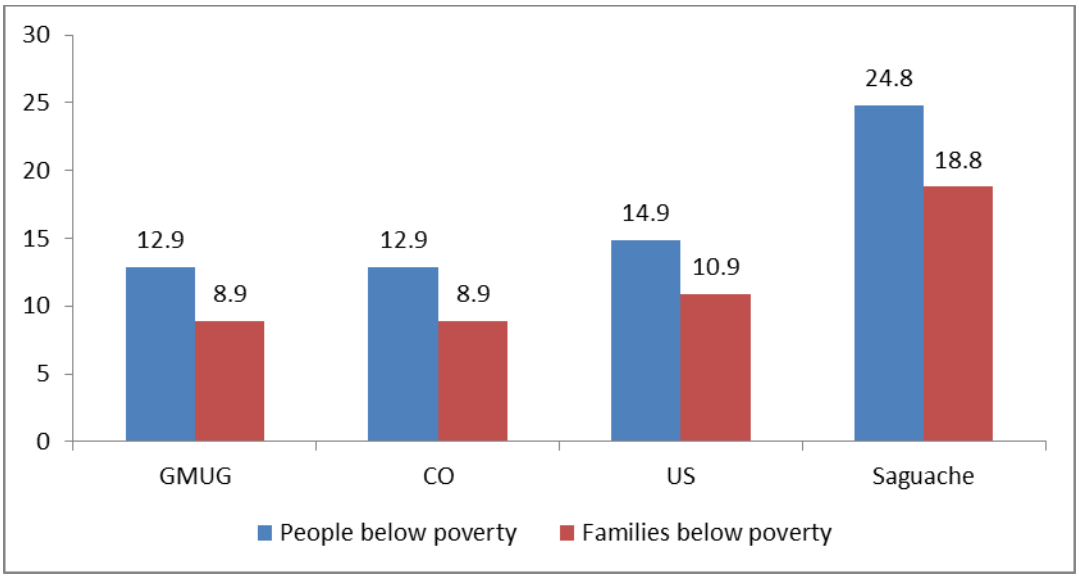

Figure 48. Individuals and families living below the poverty level, 2012 (U.S. Department of Commerce 2013).

Timber Market

In general, since the 2008 recession, the market for timber in the Western U.S. has experienced a prolonged decline which has caused wood product prices and production to drop. "Capacity utilization at sawmills and other timber-using facilities in the West fell from over 80 percent in 2005 to just over 50 percent in 2009 and 2010" (Keegan 2011). However, there is still capacity for expanding markets, such as salvaged timber for use as biomass in the energy industry.

An analysis of the market for salvageable timber (Prestemon 2013) evaluated the feasibility of harvesting and increasing mill capacities in the Western states, including Colorado. The authors found that Colorado had one of the highest amounts of dead salvageable timber, with the largest volumes on National Forest land. The analysis revealed that the costs were greater than the

revenue, most likely due to the high volume per acre removed, the resulting market saturation and lower market prices. Thus, increased timber salvage may exaggerate the already depressed market for timber in Colorado. In addition, Prestemon (2013) found that the effects of an expansion in processing capacities are smaller when only pulpwood mills are considered (not sawtimber mills) because pulpwood has lower value relative to costs. When considering the duration of expected salvage supply, when the supply is fixed due to a declining epidemic situation, the prices become less depressed; whereas if the beetle epidemic continues and salvageable timber supply is more dynamic, the prices are more likely to decline (Prestemon, 2013).

Another source of salvaged timber is from wildfires, which can be a substantial shock to timber markets. Following a wildfire, some of the dead timber is salvaged and brought to market, similar to the effect of beetle epidemics. This can flood markets, temporarily decreasing the price of timber. While processing capacity is generally too low to lead to a substantial price shock, the price of timber may increase over the long-run due to the overall reduction in timber inventories (Mercer 2000).

Non-Market Values

Because some recreational and environmental values are not traded in markets, they can be characterized as non-market values. Non-market values can be broken down into two categories, use and non-use values. The use-value of a non-market value is the value to society from the direct use of the asset; within the GMUG this occurs through recreational activities such as hiking, bird watching and OHV use. Viewing aspen groves is another popular recreational activity. The use of non-market goods often requires consumption of associated market goods, such as lodging and gas.

Non-use, or passive use, values of a non-market value reflect the value of an asset beyond its current use. These can be described as existence, option and bequest values. For example, an existence value for the GMUG might be the value individuals place on the mere existence of undeveloped scenic landscapes in the GMUG. In addition to implicit existence values, society's willingness to pay to preserve resources for future use attaches additional passive use values. The potential benefits people would receive from future use are referred to as option values when future use is expected to occur within the same generation and bequest values when preservation allows future generations to benefit from resource use. Within the GMUG, bequest and option values might exist for numerous plant species, aspen ecosystems, undeveloped scenic landscapes, wild and scenic rivers, heritage sites, and recreational trails. Rosenberger (2012) found that "non-use benefits are more than three-and-a-half times greater than recreation-use benefits." While it is difficult to quantify the significance of the non-use benefits for the SBEADMR due to unavailable information, the Rosenberger finding demonstrates that these non-use values can hold significant value and should be considered alongside the quantitative analysis.

The current damage to the GMUG from the spruce beetle and Sudden Aspen Decline may have multiple effects on non-market values. For example, the visible damage to the trees may impact the aesthetic values people derive from visiting the forest. This is partially reflected in the property values in the local area. According to Rosenberger (2012), "healthy trees add positive value to a property through aesthetic value, ecosystem services, and increased owner satisfaction." There is also evidence that forest pests, such as the spruce beetle, can reduce the quality and visitation rate for recreation. When viewsheds are impaired and the dense forest necessary for certain game species is not available, visits for wildlife viewing and hunting may decline (Rosenberger 2012).

While use and non-use values exist in the SBEADMR analysis area, valuation is not always feasible during the planning process; however, this does not preclude their consideration. Other public involvement efforts for projects in the area indicate that non-market values exist for recreation opportunities, land uses of traditional and cultural importance, and natural amenities managed by the GMUG. There is also value associated with restoration actions and a healthy Forest, such as long-term supply of ecosystem services (e.g. water quality, air quality, and biodiversity).

Alternative 1 (No Action) – Direct, Indirect and Cumulative Effects

No direct effects on the local economy would occur under the No Action Alternative. Within the 22-county analysis area, economic conditions and trends (employment, labor income, unemployment, TPI, PCPI, non-labor income, etc.) would not change relative to the SBEADMR project since no actions would be taken. In addition, any potential revenue from the sale of timber would not be realized under the No Action Alternative.

Indirect effects on local economic conditions could occur as a result of the No Action Alternative. Greater non-prescribed wildland fire-related costs could result if fuels are left untreated under the No Action Alternative. Potential threats and costs to human life, property and fire-fighter safety under the No Action Alternative would be greater than under the Proposed Action and Alternatives 3 and 4. Where hazardous fuels have been treated, fire suppression costs near values at risk, and associated risk to life and property should be less when wildland fires occur compared to areas where fuels have not been treated. However, it is not possible to predict the level and costs of non-prescribed wildland fire under the No Action Alternative.

Additionally, it is likely that the GMUG would close more areas to recreation, absent the wide-ranging hazard tree treatments included in the action alternatives. Visitors would be displaced which could change the distribution of recreation-related revenue.

Under the No Action Alternative, the impacts to some ecosystem services may be more severe. For example, for some observers, there would be higher negative impact to viewsheds from the expanses of dead, dying, and fallen trees now and in the long-term compared to the other alternatives. Although these services are difficult to quantify, they should be considered. The lack

of measurable direct and indirect effects translates to a lack of measurable cumulative effects to economic conditions under the No Action Alternative.

Environmental Justice

As indicated in the discussion above, minority and low-income populations exist in the area. While the No Action Alternative is not expected to have a disproportionately high and adverse human health or environmental effect on these communities, increased susceptibility to wildfire could result. Consequently, additional unmeasurable indirect economic effects associated with increases in wildland fire-related costs are possible, which could result in impacts to local communities. However, there is no reason to suspect that any impacts will disproportionately affect minority and low income populations.

Direct and Indirect Effects Common to All Action Alternatives

Treatment Costs

Vegetation treatment is associated with a decrease in wildfire suppression costs and a decrease in net resource damage (Mercer 2000). Treatments conducted within the wildland urban interface (WUI) are likely more expensive than treating non-WUI lands. One study found that mechanical "treatments occurring within the WUI were on average 62 percent more expensive than treatments occurring outside the WUI" (Calkin and Gebert 2006). The costs of treatment could potentially be underestimated if treatments were implemented within the WUI. The cost of sale preparation for salvage treatments includes both roadside (WUI) and non-roadside costs.

Fuel reduction projects in and outside of the WUI can significantly reduce the risk of damage to values at risk from catastrophic wildfire (WFLC 2010). However, assessing the cost-benefit ratio of fuel reduction projects is questionable without information on the degree to which treatment reduces the risk of wildfire near values at risk. Furthermore, the scale and cost of prevented wildfire damage to values at risk is uncertain and widely variable. Anticipated reductions in the threat to human life and decreases in wildland fire-related costs such as property loss, lost revenues and suppression costs are not included in the analysis of PNV for the alternatives. While the PNV of treatments is negative under all alternatives, the prevention of damage to values at risk from one large fire could significantly increase the PNV of treatments.

As a result of the treatments proposed under all of the alternatives, the long-term provision of forest products will provide the opportunity for timber market stewardship contracting and improved utilization. Populations in the analysis area would be supported by both recovery and resiliency treatments. Furthermore, resiliency treatments provide ecosystem services. Table 87 shows the project area's potential for forest products in terms of maximum expected forest product volumes from treatments proposed under each alternative. These are the maximum annual volumes expected to occur for 10 years, or the timeframe used here for analysis purposes.

Timber Market

The economic effects of increased merchantable timber as a result of the SBEADMR project are important to consider. The SBEADMR project could increase the amount of timber on the market and also has the potential to affect the local energy industry. In addition, while the management alternatives assume full utilization by local processing, there is a chance that the local market may not be capable of full utilization of the resulting timber. As a result, the employment and labor income effects may be a maximum potential contribution under the alternatives.

While the market for timber may still be depressed, the prospective new and current uses in the GMUG region have the potential to fill the gap. Public Law 108-7 grants the Forest Service ten-year authority to enter into stewardship contracts or agreements to achieve agency land management objectives and meet community needs, which can encourage lumber companies to invest in new technologies to improve harvest techniques in the long-term.

The timber industry may benefit from a higher quality harvest of wood products, and local economies could experience such benefits as increased jobs and income, public safety, and local energy supply.

Public Concern with Health and Human Safety

The effects to human health and safety from water and air quality, wildfire risk, and hazard trees are assessed in other sections of this EIS.

Non-Market Values

Resource-related impacts addressed in other sections of this document have the potential to negatively impact non-market values in the short-term. These include soil compaction, soil sterilization, spread of noxious weeds, impacts to water quality or quantity, modified recreation opportunities during project implementation, impacts on air quality during treatments, impacts on visual resources from smoke or mechanical treatments, increases in temporary road density, increases in activity, impacts to wildlife, etc. These particular impacts may reflect the personal sensitivities of individuals to a change in their environment, may impact ecosystems that relate to particular uses of an individual (for example, presence of game during a hunting season in a particular hunting unit may be disrupted during implementation), or other non-use values (for example, clean air or water). The potential for physical impacts as identified in other sections will be mitigated through the use of design features inherent to all action alternatives, and these should be relatively short-term in nature; however, individuals and populations may perceive effects related to their experiences or preferences that may last much longer, such as impacts on a viewshed or scenic vista or, at a smaller scale, the presence of slash, stumps or burn scars in a particular treatment unit.

The action alternatives also have the potential to positively impact non-market values. Prescribed burning would be completed to spur regeneration of aspen and reduce the risk from wildfire that

is driven by fuel accumulations. Reduced risk of wildfire has economic benefits, but also has non-market values such as the peace of mind that fire-safe land can provide community members. Additional non-market benefits from regenerated aspen stands may include enhanced recreation that is aesthetically pleasing, improved biodiversity of plant and animal communities, and the protection of watersheds.

Effects from fuels treatments will mostly be localized and benefit the areas in the WUI. Enhanced public safety due to a reduced threat of wildfire is a non-market value that would be realized, for the most part, by people living and working in the WUI, where treatments are concentrated near communities and public infrastructure. In addition, the spruce salvage and resiliency treatments are expected to reduce crown fire risk for red-stage stands. Additionally, an indirect effect of removing some tree material through salvage treatment is that future fires may impart lower severity, leading to less disruption of soil and watershed-related ecosystem functions. However, these effects will not likely change the overall fire behavior in the surrounding areas or the overall provision of ecosystem services. Benefits may accrue in the local areas where treatments occur and properties within the WUI from reduced wildfire risk.

The spruce-fir resiliency treatments are expected to improve stand conditions. The resiliency treatments are expected to reduce the impact of the spruce beetle and other stressors on the stand, which would as improve aesthetics of viewsheds and/or recreational experiences in the long-term.

Summary of Financial Efficiency

Economic efficiency analysis measures the ratio of economic benefits to economic costs resulting from activities under the SBEADMR project. Vegetation treatments in SBEADMR are proposed to meet both commodity and non-commodity objectives. Not all associated costs and benefits can be monetized due to data limitations and uncertainty. Therefore, the following discussion of financial efficiency is primarily descriptive in its analysis of tradeoffs.

Table 89 summarizes the Present Net Value (PNV) of the different alternatives from the Forest Service perspective and includes all available quantifiable costs and benefits (revenue) associated with these activities. A 4 percent discount rate was used over a period of 10 years (2015-2024). Over the 10-year treatment period, SBEADMR is expected to cost the Forest Service between $46.5 million and $49.9 million. This is the discounted cost of the project to the government. The anticipated revenue for the Forest Service from the timber harvest (benefits) is expected to range from $16 million to $19.5 million.

Table 89. Present Net Value of SBEADMR Treatments over 10-year Period, 4 Percent Discount Rate.

	No Action Alternative	**Alternative 2**	**Alternative 3**	**Alternative 4**
All Proposed Project Activities- Timber Harvest and Vegetation Management				
PV Costs	$0	$48,586,293	$49,877,143	$46,469,350
PV Revenue	$0	$16,059,574	$17,843,971	$19,466,150
Present Net Value	$0	*-$32,526,720*	*-$32,033,172*	*-$27,003,200*

An important aspect of the financial efficiency analysis of forest treatment is the relationship between treatment (prescribed burning and mechanical thinning) and wildfire risk to values at risk in the WUI (incidence) and hazard (severity) reduction in the WUI. Mercer (2000) notes that treatment is associated with a decrease in wildfire suppression costs and a decrease in net resource damage; however, the precise relationship between treatment and wildfire cost reduction is not identified, and therefore neither quantified nor incorporated into the PNV analysis.

Summary of Regional Economic Impact Analysis

Employment and labor income supported by forest management actions under the action alternatives are displayed in

Table 90. Results for Alternatives 2, 3, and 4 reflect an increase in employment and income generated by proposed activities. These activities include harvesting and processing of commercial forest products, activities associated with resiliency treatments, and road work.

Table 90. Total (Direct, Indirect and Induced) Average Annual Employment and Labor Income for All Alternatives.

Category	No Action Alternative	Alternative 2	Alternative 3	Alternative 4
Employment (Full- and part-time jobs)				
Timber Harvest-Resiliency	0	332	158	0
Timber Harvest-Salvage	0	1,232	1,580	1,896
Vegetation Management Activities*	0	58	41	58
Road Work	0	3	2	3
TOTAL	0	1,625	1,781	1,957
Labor Income (thousands of 2012 dollars)				
Timber Harvest-Resiliency	$0	$12,691	$6,043	$0
Timber Harvest-Salvage	$0	$47,138	$60,433	$72,520
Vegetation Management Activities*	$0	$1,635	$1,343	$1,635
Road Work	$0	$154	$90	$154
TOTAL	$0	$61,618	$67,910	$74,308

Environmental Justice

In the 22-county analysis area, four counties, Montezuma, Rio Grande, Saguache, and Lake, have been identified as possible EJ populations, meeting minority and/or low-income criterion under EO 12898. Since vegetation treatments are not expected to occur in Montezuma, Rio Grande, or Lake Counties, no disproportionate high and adverse impacts to those EJ populations would be expected. They were included in the analysis area because they are considered part of the functional economy for the GMUG, however, the social impacts will likely be minimal. Saguache County will likely receive vegetation treatments as a result of the SBEADMR, however, the treatments would be spread out across the landscape and are not concentrated in specific areas and are not expected to have a disproportionate high and adverse impact to any EJ populations.

There are social values for local access and recreation in the analysis area, as highlighted through scoping and public comments. These values can sometimes have greater impacts on EJ populations that rely on natural resources in the Forest for basic needs, such as fuelwood. EJ populations can also have limited access to green space, which is an environmental amenity that is often associated with higher income areas. However, impacts to access to NF land for subsistence uses and impacts to recreation will be minimized under SBEADMR, based on the application of design features to all action alternatives. One of the SBEADMR design features limits long term interruption to access with the use of flaggers and timing of road closures. While there may be a higher frequency of short-term access interruptions under Alternative 3 since it is focused on hazard tree removal near existing roads, the design features consistent across all alternatives ensure that road closures would not significantly limit access or use to the Forest for anyone.

Therefore, the Proposed Action and Action Alternatives are not expected to have disproportionately high and adverse effects on the EJ populations in the analysis area.

Furthermore, other resource impacts are not expected to be more concentrated in proximity to these populations, leading to no disproportionate human health or environmental effects on these populations.

Alternative 2 (Proposed Action) – Direct and Indirect Effects

Financial Efficiency

Table 89 summarizes the projected financial efficiency for Alternative 2. The PNV indicates the financial efficiency of the salvage and resiliency activities, including all costs and revenues associated with the activities and required design features. As noted in Table 87, restoration activities examined under this alternative include (among others) resiliency and salvage treatments, prescribed fire, mastication, weed spraying, and planting. A 4 percent discount rate was used over a period of 10 years (2015-2024).

Table 89 indicates that the proposed action alternative is not financially efficient for the timber harvest and required design features, as well as for all vegetation management activities noted above, as indicated by the negative PNV. The PNV for the proposed action is negative $32.5 million. However, since the PNV does not include non-market values such as ecosystem services, this is likely an underestimate. The estimated revenue from treatments is the lowest under Alternative 2, but costs from Alternative 2 arelower than the costs from Alternative 3 since treatments in the WUI are more expensive and Alternative 3 has more treatments in the WUI. The expected non-market values derived outside of the WUI will likely be greater under Alternative 2 than Alternatives 3 and 4 because Alternative 2 has the highest amount of resiliency treatments that will improve the overall health of the forest.

Indirect effects on financial efficiency could occur as a result of the proposed action alternative, however, estimates of these changes are not available. It is anticipated that fuels treatments under this alternative would contribute to fuels conditions that would have more resistance to wildland fire. This would likely reduce the threat to human life and decrease wildland fire- related costs such as property loss, lost revenues and suppression costs.

Regional Economic Impact Analysis

Timber production and vegetation management activities from this project would have direct and indirect effects on local jobs and labor income.

Table 90 displays total estimates (direct, indirect and induced) for employment (full- and part-time) and labor income that may be attributed to the alternatives on an annual basis. Since the expenditures occur over a 10-year period, the estimated impacts of jobs and labor income would be spread out over the life of the project. These are not new jobs or income, but rather jobs and income that can be attributed to this project. Under the Proposed Action, it is estimated that 1,625 jobs and $61.6 million in labor income will be attributed to the SBEADMR project annually. Employment associated with all activities under this alternative would constitute 0.43 percent of total employment in the 22-county analysis area.

Salvaged timber harvest would be responsible for the majority of the total jobs and the total labor income for the project. The analysis assumes the timber volume processed would occur within the 22-county analysis area. However, if some of the timber were processed outside the region, then a portion of the anticipated jobs and income would not be realized in this regional economy.

Overall recreation visitation on the forest is not anticipated to change in the long-term, however short-term shifts in use on the forest could occur. Consequently, no change in recreation visitation and related economic impacts are anticipated, given the availability of substitute sites on the forest. As a result of short-term road closures due to maintenance and construction, there may be short-term impacts to recreation access in the local area. Under Alternatives 2 and 4, there will likely be higher need for temporary road closures and therefore greater short-term impacts to access for recreation use.

Alternative 3 (Public Safety Focus) – Direct and Indirect Effects

Financial Efficiency

Table 90 summarizes the projected financial efficiency for Alternative 3. The PNV indicates the financial efficiency of the timber sale and vegetation management activities, including all costs and revenues associated with the activities and required design criteria. Vegetation management activities examined under this alternative include (among others) resiliency and salvage treatments, prescribed fire, mastication, weed spraying, and planting. A 4 percent discount rate was used over a period of 10 years (2015-2014).

Table 89 indicates that Alternative 3 is not financially efficient for commercial activities and required design features, as well as for all vegetation management activities noted above, as indicated by the negative PNV. The PNV for Alternative 3 is negative $32 million. However, since the PNV does not include non-market values such as ecosystem services this is likely an underestimate. The estimated costs of treatments are the highest under Alternative 3 since it is focused on more expensive treatments in the WUI. For people living within the WUI, the expected non-market values derived from Alternative 3 will likely be greater than under the other action alternatives, due to the shift in the geographic location of treatments and focus on public safety. Other non-market values derived from treatments within the WUI are from aesthetically pleasing landscapes and recreation opportunities; these may be greater within the WUI under Alternative 3 than under the Proposed Action Alternative and Alternative 4.

Indirect effects on financial efficiency could occur as a result of Alternative 3, however, estimates of these changes are not available. It is anticipated that fuels treatments under this alternative would contribute to fuels conditions that would have more resistance to wildland fire. This would tend to reduce the threat to human life and decrease wildland fire-related costs such as property loss, lost revenues and suppression costs. Since Alternative 3 was developed with a public safety focus to treat areas in and around the WUI, the expected costs from wildfire related to human safety and property damage would be lowest under this alternative.

Regional Economic Impact Analysis

Table 90 displays total estimates (direct, indirect and induced) for employment (full- and part-time) and labor income that may be attributed to the alternatives on an annual basis. Since the expenditures are estimated to occur over a 10-year period, the estimated impacts of jobs and labor income would be spread out over this period. These are not new jobs or income, but rather jobs and income that can be attributed to this project. Under Alternative 3, it is estimated that 781 jobs and $67.9 million in labor income will be attributed to the SBEADMR project annually. Employment associated with all activities under this alternative (

Table 90) would constitute 0.47 percent of total employment in the 22-county analysis area.

As under Alternative 2, salvaged timber harvest would be responsible for the majority of the total jobs and the total labor income for the project (

Table 90). The analysis assumes the timber volume processed would occur within the 22-county analysis area. However, if some of the timber were processed outside the region, then a portion of the jobs and income would be lost by this regional economy.

Overall recreation visitation on the forest is not anticipated to change in the long-term, however short-term shifts in use on the forest could occur similar to Alternative 2. As a result of short-term road closures due to maintenance and construction, there may be short-term impacts to recreation access in the local area. Alternatives 2 and 4 include a higher maximum estimate of road construction whereas Alternative 3 includes a higher maximum estimate of miles of road maintenance.

Alternative 4 (Spruce Salvage) – Direct and Indirect Effects

Financial Efficiency

Table 89 summarizes the projected financial efficiency for Alternative 4. The PNV indicates the financial efficiency of the proposed spruce recovery and aspen treatment activities, including all costs and revenues associated with the activities and required design criteria. As seen in Table 87, vegetation management activities examined under this alternative include (among others) spruce-fir salvage and aspen resiliency treatments, prescribed fire, mastication, weed spraying, and planting. A 4 percent discount rate was used over a period of 10 years (2015-2024).

Table 89 indicates that Alternative 4 is not financially efficient, as indicated by the negative PNV. The PNV for Alternative 4 is negative $27 million. However, since the PNV does not include non-market values, such as ecosystem services as discussed above under the section "Effects Common to all Alternatives," this is likely an underestimate. The expected non-market values derived from Alternative 4 will likely be greater than Alternatives 3 and similar to those of Alternative 2.

Indirect effects on financial efficiency could occur as a result of Alternative 4, however, estimates of these changes are not available. It is anticipated that fuels treatments under this alternative would contribute to fuels conditions that would have more resistance to wildland fire. This would tend to reduce the threat to human life and decrease wildland fire-related costs such as property loss, lost revenues and suppression costs.

Regional Economic Impact Analysis

Table 90 displays total estimates (direct, indirect and induced) for employment (full- and part-time) and labor income that may be attributed to the alternatives on an annual basis. Since the expenditures occur over a 10-year period, the estimated impacts of jobs and labor income would be spread out over this period. These are not new jobs or income, but rather jobs and income that can be attributed to this project. Under Alternative 4, it is estimated that 1957 jobs and $74.3 million in labor income will be attributed to the SBEADMR project annually. Employment associated with all activities under this alternative (

Table 90) would constitute 0.52 percent of total employment in the 22-county analysis area. Alternative 4 is expected to have the greatest impact to jobs and labor income in the analysis area. While the total number of acres treated is the same between Alternatives 2, 3, and 4, under Alternative 4 the harvest volume is greatest.

The analysis assumes the timber volume processed would occur within the 22-county analysis area. However, if some of the timber were processed outside the region, then a portion of the anticipated jobs and income would not be realized by this regional economy.

Overall recreation visitation on the forest is not anticipated to change in the long-term, however short-term shifts in use on the forest could occur. Consequently, no change in recreation visitation and related economic impacts are anticipated, given the availability of substitute sites on the forests. As a result of short-term road closures due to maintenance and construction, there may be short-term impacts to recreation access in the local area. Alternatives 2 and 4 include a maximum estimate of more road construction whereas Alternative 3 includes a higher maximum estimate of road maintenance miles. Under Alternatives 2 and 4, there would likely be more road closures and therefore greater short-term impacts to access for recreation use.

Cumulative Effects Common to All Action Alternatives

Cumulative effects of management actions need to be considered in conjunction with the direct and indirect effects of other past, present and reasonably foreseeable activities being conducted in the 22-county analysis area. Past and present cumulative economic activity has already been absorbed by the local economy and is represented in the affected environment section presented above. For example, the employment distribution and specialization presented in Figure 45 reflects past and present activities on all land ownerships and jurisdictions in the analysis area. Any change in the economic environment as a result of management actions would be in addition to other activities occurring simultaneously in the analysis area as well as those that could reasonably occur in the future. Each treatment may have a very small effect on the social and economic conditions of the analysis area individually; however, cumulatively they could change the distribution of jobs and income, as well as affect the social and economic variables discussed above. As noted in the analysis of employment and labor income impacts above, impacts associated with all activities under this alternative would constitute less than one percent of employment and labor income totals in the 22-county analysis area. The small cumulative economic impact from past and present activities indicates cumulative economic effects related to reasonably foreseeable activities are likely to be small.

Recreation Use

Affected Environment

Recreational use on the GMUG occurs across the Forests. Use is focused at ski areas, developed recreation sites, on/along roads and trails and on/along water-ways. Hunting is the primary use that extends further away from travel routes. Secondly, personal use gathering of forest products

extends some distance away from travel routes. During the snow season, multiple over-snow activities occur on travel routes and away from those routes. This section will focus on public safety, recreation access and the recreation settings. These are the elements that the projects formulated under this document could affect.

Two goals of recreation management on GMUG are to provide for public safety and for enjoyable experiences. People engage in many different activities as they seek enjoyable experiences. Activities are frequency described as non-motorized or motorized. Some are considered high challenge, while others are more sedentary and lower challenge. Hazardous trees affect safety along roads, trails and in sites where people are staying. The forest setting is sought to engage in these activities. That setting is valued for its topography, scenic views, water features, forests and openings. Within the forested landscape, people value healthy, natural appearing areas. The value of natural appearing areas tends to be lower in less dense areas of trees, value increases with increasing density, to a point where the forest appears crowded, thick and blocks views deeper into or through the forest. Variety of the forest appearance enhances peoples' perception of the forest condition and their appreciation of the scenery and the enjoyment of their experience.

This section will focus on public safety and recreational experiences that visitors are seeking. First, we will describe the types of experiences that people are seeking in general, then we will discuss the facilities and opportunities that are available on the Forests. We are excluding Wilderness Areas, the Fossil Ridge Recreation Area, and Colorado Roadless Areas from consideration for projects in this EIS (See Chapter 2, *Opportunity Areas Defined*). Therefore, we will not address these areas, however, access points that are outside those areas and within the identified opportunity areas are addressed.

Recreation Use

Recreational use on the GMUG is quantified by the National Visitor Use Monitoring Program (NVUM) (surveys of fiscal years 2009 and 2014). The reports estimate that the GMUG has 2.49 (90% confidence 2.11 – 2.86) million national forest visits annually. A national forest visit is defined as the entry of one person upon a national forest to participate in recreation activities for an unspecified period of time. A national forest visit can be composed of multiple site visits. A site visit refers to the entry of one person onto a national forest site or area to participate in recreation activities for an unspecified period of time. Slightly more than half of the visits came from people traveling 50 miles or less to the forest. About 66% percent of visitors travelled 75 miles or less. This leads to the conclusion that most visitors to the GMUG are western slope residents. About 33% of GMUG visitors came to the forest 30 to more than 300 times per year. Fifty percent came more than 10 times per year, so more than half of GMUG recreation visitors visit multiple times each year.

The greatest primary recreation activity on the forest is downhill skiing and snowboarding (39%) followed by hiking/walking (9.9%) and cross-country skiing (9.3%). When we take out downhill

winter sports from the primary activities, we see the following primary activity rates and average hours during each visit for that activity:

Hiking/walking (16%) – 4 hours
Cross-country skiing (15%) – 2.6 hours
Snowmobiling (14%) – 4.9 hours
Viewing natural features (11%) – 5 hours
Fishing (11%) – 5.8 hours
Driving for pleasure (8%) – 3.9 hours
Motorized trail activity (5%) – 7.5 hours
Relaxing (4%) – 20.5 hour

For activities with less than 6 hours of that activity, it appears that those activities are mainly day-use. Where the activity lasts more than 6 hours, that activity appears to be supported by overnight camping on the Forests.

Camping is also a regular activity on the Forests with 5% participation at developed sites and 4% at dispersed sites. About 2% and 1% respectively consider these their main activities. These are longer duration activities with 37.5 hours and 61.4 hours, respectively, being the average duration for camping when it is their main activity. We conclude that while relatively smaller numbers of people consider camping their primary activity, for about half of the campers, camping supports other main activities.

Recreation Opportunities

Ski Areas

Skiing at developed ski areas is a high proportion of the recreation use on the GMUG. All of this use is day-use by definition in the NVUM surveys - all participants spend the night off of the Forests. In terms of how vegetation affects these activities, it is critical that trees do not fall in the skied portions of the area for safety reasons. Vegetation provides the wind-screening necessary for snow accumulation and provides the setting for enhanced visual appearance of the area. There are 3 ski areas on the GMUG that occur in the treatment opportunity areas. The potential treatments in these areas do not include commercial mechanical or broadcast burning.

Developed Recreation

Developed recreation sites support recreational activities both on-site and off-site. Developed sites that support on-site recreational activities are typically campgrounds, rental cabins, picnic grounds, visitor centers, interpretive sites (natural and heritage) and scenic/wildlife viewing sites. Developed sites that support off-site activities are trailheads, fishing access sites, and boating access sites and sites identified as day-use sites which typically support multiple activities. These

sites are easy to identify, as they usually have a substantial sign that identifies them and there is considerable investment in facilities such as roads/parking, toilets, tables and other infrastructure.

Many or most developed sites on the GMUG occur in treatment opportunity areas and an objective of this program is to treat these areas for safety, as dead or dying trees are a hazard to people and property that use the area. The condition of the forest surrounding these areas is important to visitors as it serves as a gateway to other activities or people are residing at these sites for significant period of time.

Dispersed Recreation

Most recreational activities that occur on the forests that do not involve constructed facilities are considered dispersed recreation. Many motorized activities occur on the roads within the forests, ranging from scenic drives in passenger vehicles, Off-Highway vehicle use and ATV/Motorcycle riding. Trails support some of these motorized activities along with mountain biking, horseback riding, hiking/walking. Other examples of dispersed recreation include camping (outside of developed campgrounds), photography, wildlife viewing and sightseeing as well as hunting and fishing, boating, snowmobiling and cross-county skiing/snowshoeing.

Dispersed Camping/Gathering Sites

Dispersed camping occurs along roads primarily and can occur along trails. Some of these areas are designated for camping and others are locations where people have established informal camping spots. The agency is concerned about safety at any locations that people gather or gather and reside. The presence of dead or dying trees is a hazardous situation. Visitors must take personal responsibility for ensuring that their location is safe from hazardous trees.

A large number of these types of sites are likely to be within treatment opportunity areas. Treatments would focus on reducing hazard trees in the area around the site. Treatments affect the appearance of the forest which affects the visitors satisfaction with the setting. Due to the longer term nature of use in these areas, the appearance has a larger impact on the visitor, than driving by a treatment areas.

Roads

The road system is discussed in other sections of this document. From the recreation perspective, the road system is very important to the recreating public. It provides for access and it provides the opportunity for some of the activities discussed previously.

Treatment opportunity areas are along a large number of roads. It is important that travel on and along the roads is safe, which is an objective of this program. The recreation visitor and the visitor driving through the forest will also be viewing or using the forest. It is important the appearance of the forest following treatment is maintained with a pleasing appearance. Road

reconstruction is identified as an activity associated with some treatments. For recreation visitors, the condition of these roads is important. While access to the roads during treatment may impact visitors, it is most important that the condition of the roads following treatment is considered. Where we have objectives for passenger car travel, that user expects a reasonably smooth drive. Where we currently have roads that are more challenging, it is important to maintain that challenge level, unless we make explicit decisions to change the character of the road.

Trails

The trail system within the GMUG consists of 946 trails totaling 3,556 miles in length. About half of the trail mileage is not designated for motorized use and are used for hiking, backpacking, horseback riding and mountain biking. The other half of the mileage is designated for motorized recreation such as OHVs, ATVs, and motorcycles. On some motorized trails, non-motorized uses can also occur. There are a number of nationally designated Recreation Trails and the Continental Divide National Scenic Trail on the GMUG.

A number of the nationally designated trails and many of the remaining trails exist in the treatment opportunity areas. Treatments have not been identified to occur for improvement of safety on or along the trails. Treatments may affect the safety and the appearance of the forested environment along the trails.

Winter Trails

The GMUG supports a wide range of winter recreation including snowmobiles, cross-country skiing, sledding, snowshoeing and dog-sledding. Many of these trails or areas could be in treatment opportunity areas. The program being proposed in this document does not have an objective of treating these trails for safety. It will be important to consider public safety and the appearance of the forest during and after treatment operations in the vicinity of these facilities. Also, winter activities can be affected by treatments and the management of the roads accessing those treatments during the winter. Plowing a road can completely change the uses in those areas. There are designated, managed snow trails for skiing and snowmobiling. These trails are managed in partnership with local clubs.

Lakes and Streams

Fishing and use of water features for other recreation activities is very important on the GMUG. Treatment opportunity areas surround an number of lakes, streams and rivers. As with other sites where people remain for a period of time, public safety is very important. Dead and dying trees are a safety hazard which should be mitigated when treatments are considered in the vicinity of water features, especially those that are frequently used. The condition of the forest following treatment is very important for safety and appearance. Previous discussions about both aspects apply.

General Forest

The general Forest away from the facilities and features discussed previously in this section do not receive appreciable use. Previously we identified hunters and forest product gatherers as primary users away from developed facilities, roads and trails. Certainly there are other users such as photographers and nature study enthusiasts that enjoy the general forest. Treatments can have on impact on these areas. Due to the low amount of use in these areas and the inability to reasonably control the natural environment across vast acreages, the maintenance of public safety is lower priority here. Likewise, the importance of the appearance of the forest following treatment is less important, but should be considered. It is important that treatments that are adjacent to travel corridors, lakes and streams and the vicinity of dispersed sites are designed to not detract from the appearance of the condition of the environment from those sites. It is also important to design those treatments so that it is difficult for people to make new travel-ways from the existing travel-ways.

Recreation Special Uses

Recreation special uses include recreation residences, lodges, organization camps, outfitter-guides, recreation events, and other permitted recreation activities. The GMUG has issued special use permits for activities including outfitters and guides, and non-commercial groups such as weddings, rallies or other events. Commercial permits are issued for such events as races, jeep

rallies, wagon trains and concerts. Other permits are issued for activities that involve permanent and immobile structures such as recreation residences and ski areas and resorts. We discussed Ski Areas in a previous section, so they will not be discussed here.

Recreation Residences, Lodges/Resorts and Organization camps occur in treatment opportunity areas. These areas have significant infrastructure, and provide for recreational activities on-site and support recreational activities off-site. Working with these entities to provide for safety from dead or dying trees is important. Protecting their safety and their infrastructure during operations is important. The appearance and condition of the forest following treatment is important.

Recreation Events are permitted on the GMUG. Some are regularly occurring events and some are less frequent or one-time-only events. Events can be confined to a defined area or they may occur on roads and trails. Coordination of treatment activities with recreation events, especially for regularly occurring events, is very important. It is also important for permits that are granted sometimes 6-12 months in advance. Ensuring that we don't inadvertently modify areas where events have occurred for many years and where they are currently planned is important. Public safety and access is important when events are occurring. The condition of the forest following treatment is important for regularly occurring events.

Outfitter-guides provide a large number of different services to visitors. Their activities include: fishing, hunting, boating, hiking, ATVing, OHVing, snowmobiling, horseback riding, and others. The previous statements we have made about roads and trails apply here also. Activities along lakes and streams were also addressed previously as well as the general forest area. The Forest Service has made long term commitments to many of these providers. It is imperative that we consider the impact of these activities on the providers by insuring that we don't disrupt their operations and that we consider their activities during the design and implementation of treatments. Their safety and the appearance of the forest following treatment is important.

Management Areas that Emphasize Recreation Opportunities

On the GMUG, there are 3 Management Areas that emphasize recreation opportunities, not including Management Areas for Downhill Skiing (1B) and Developed Recreation Sites (1D). These areas are: Semi-Primitive Motorized Recreation Opportunities(2A), Roaded Natural and Rural Recreation Opportunities (2B) and Semi-Primitive Non-Motorized Recreation Opportunities (3A). Dispersed Recreation, Trails, and Recreation Special Uses occur in these 3 Management Areas, as well as the other Management Areas identified in this document. In these 3 Management Areas, Recreation Opportunities are emphasized over other resource values.

In 3A areas, the expectation is that the sights and sounds of human activity are fairly low. The evidence of human activity is subordinate in the environment, so natural appearance is expected. Sounds from communities and motorized vehicles are expected to be infrequent or very distant.

Treatments in these areas should harmonize with the environment and sounds from the treatments should avoid periods of higher use.

In 2A areas, the expectation is that the sights of human activity are fairly low, but the sounds of human activity, primarily from motorized vehicles are expected. The evidence of human activity is subordinate in the environment, so natural appearance is expected. Treatments in these areas should harmonize with the environment and sounds from the treatments would be consistent with these areas.

In 2B areas, which are typically along major road corridors, the expectation is that the sights of human activity is common, but the natural environment that isn't devoted to infrastructure will be pleasing and support the recreation activities sought in these areas. The sounds of human activity, primarily from motorized vehicles and other people are expected. There are generally much higher numbers of people recreating in these areas. There may be greater concern with treatment activities that are inconsistent with the desired recreational setting.

The other resource emphasis Management Areas also support recreation activities, however the other resource emphasis in those areas is more important than recreational pursuits. Key recreational areas outside of developed recreation sites in these areas should be considered during project implementation. Roads, trails, lakes, streams, and dispersed camping areas are features that attract visitors. Efforts to protect recreation opportunities in these areas should be considered where possible and where more frequent use is occurring and where consistent with the other resource emphasis.

Alternative 1 (No Action) – Direct and Indirect Effects

Through implementation of the No Action Alternative, typical management practices would continue, including hazard tree removal within developed recreation sites, in areas of concentrated use in the general forest, and along trails. However, such removal would not be made in a concerted effort or within the scope and timeframe of the Proposed Action Alternative.

Developed Recreation

Past and current management activities include an annual inspection and removal of hazard trees in campgrounds and other developed recreation areas, including rental cabins. Under the No Action Alternative, annual removal of all documented hazard trees or tree limbs would continue at its current limited scope, with assistance from timber management, forest health management, and recreation specialists, or the sites would be closed. It is expected that the number of hazard trees would increase over time as the current bark beetle epidemic continues such that it would overwhelm our capacity for mitigation under the current methodology and budget. This would cause certain campgrounds, picnic areas and other recreation sites to delay opening, close access roads, or even close the entire facility for several months or up to multiple seasons. Hazard trees would continue to fall within sites closed for any length of time, potentially damaging the

infrastructure such as picnic tables, restrooms, roads and administrative buildings, which would be additive to the length of time the site would be closed, as well as the costs associated with reopening the sites. Closures of recreational sites would be expected to last as long as the standing dead trees are present in the sites and may continue as long as necessary to clean-up or refurbish the sites for re-opening. Such conditions would be relative to concentrated fuel loads or damages to infrastructure within the boundaries of recreational areas.

The appearance of the residual stand in developed recreation sites is important. Due to the nature of this epidemic, the appearance of the area will be altered and evident for many years to come, as the stand regains a fuller forested character. Clean-up of the areas to a more natural appearance without a lot of slash or fallen trees would be extended over a long period of time. In areas where people do not reside, it is likely that slash will remain much longer than in areas where people have campfires.

Dispersed Recreation Sites, General Forest Area and Trails

Under the No Action Alternative, standing dead trees are likely to fall in dispersed recreation areas and across roads/trails, creating dangerous conditions for visitors, travelers and hikers. When people gather in areas of the forest, the presence of standing dead trees present a risk. Under the No Action Alternative, none of these sites are likely to be treated or cleaned up outside the current capability of the agency. That capability is very low and would only be able to be applied to a few, highly important locations. As trees fall across roads/trails, under the No Action Alternative, they would continue to be cut under the current capability of the agency. As with dispersed sites. the capability to respond to these situations is low.

It may become necessary to close sites, areas and trails to the public when the situation is deemed unsafe for human occupancy. Unauthorized routes around downed trees may be created, potentially causing soil compaction, erosion and damage to watersheds. For motorized uses, when trees fall across travel routes, they present a high hazard when they are not visible to travelers. Motorcycle, ATV and OHV users may encounter a fallen tree without any forewarning. There may also be other public safety impacts, such as visitors becoming trapped in remote regions due to trees falling, which may require personnel and other resources for rescue operations.

In summary, the lack of capability to respond to hazardous tree situations will result in loss of opportunity for recreations activities. The quality of the recreation experience would be diminished with difficult access and difficult sites conditions. Areas that aren't cleaned up will not have a pleasant appearing environment for recreation. Efforts to encourage re-growth won't be undertaken, so the duration of an impacted forest will be longer.

Recreation Special Uses

Under the No Action Alternative, effects would likely be realized at recreation residences, lodges, organization camps, and ski resorts. Owners of these facilities would need to address the safety aspects of hazard trees to their facilities, use and operations. There would not be larger scale treatment activities in the vicinity that could be coordinated with these owners occupying National Forest System lands.

Outfitter/Guides and Recreation Events would be affected by the factors discussed in Developed or Dispersed Recreation sections. Business opportunities would be adversely impacted.

In both of these types of use, facility based and guides/events, opportunities for the public would be diminished due to safety concerns. Additionally, the quality of the experience would be diminished as discussed in the previous discussions about Developed and Dispersed Recreation. Relocation of activities may be possible. Given the extent of the bark beetle epidemic, it is not likely that similar settings which do not have safety, setting, or experience impairments would be found on this Forest or adjacent affected Forests.

Alternative 1 – Cumulative Effects

There are no proposed management activities under Alternative 1. Therefore, no changes to recreation will result from the implementation No Action Alternative. However, the direct and indirect effects of natural processes in combination with past, on-going, and future activities could result in cumulative effects to recreation. With fewer treatments of hazard trees, more facility and area closures would occur to protect users until such time that the Forest Service can treat them. Closures of areas may be long-term, and would affect recreation opportunities.

Effects Common to All Action Alternatives

The following design features are applicable to all action alternatives.

Table 91. Design Features for Scenic Quality and Visual Resources.

Design Feature	Trigger for Use	Description	Effect
REC-1	In campgrounds	Avoid use of broadcast burning or piling and burning treatments in campgrounds.	Limit immediate and longer-term visual impact of treatments.
REC-2	In developed recreation sites	Developed recreation sites: Managed by concessionaire: plans need to consider impact to summer operating season and should minimize impacts to operations as much as possible. For Forest Service operated sites: coordinate with District to address any District concerns	Coordinate potential conflicts between timing of treatment implementation and recreation use.

Design Feature	Trigger for Use	Description	Effect
		regarding impact to the operating season.	
REC-3	In developed recreation sites, dispersed recreation sites, trails and roads.	Coordinate with District recreation staff regarding any treatment-related closures for developed recreation sites, dispersed recreation sites, trails and roads.	Coordinate potential conflicts between timing of treatment implementation and recreation use.
REC-4	For all treatments	Special Uses: Work with recreation residences, lodges and organization camps to design treatments adjacent to these tracts to also treat these tracts to the extent feasible. Coordinate with District recreation staff to address treatment-related impacts to special use permit holders in the treatment area.	Minimize conflict with special use permit holders; seek opportunities to design treatments to benefit recreation residences, lodges, and organization camps in the vicinity of planned treatments.

Alternative 2 (Proposed Action) – Direct and Indirect Effects

Developed Recreation Areas

Implementation of the Proposed Action would result in positive safety effects on treated recreational sites and facilities, including: campgrounds, picnic areas, trailheads. The effect on existing recreational activities may range from closure of a developed campground for a week to an entire season while hazard trees are cut and removed from the treatment area.

Treatments in developed recreation sites would accelerate removal of hazard trees over the typical rate without treatments. Site will be less likely to be closed for multiple years as they would be when numerous hazard trees exist and the capability of removing them is left to normal capacity. The experience after treatment compared to treatment under normal capacity, as described in the No Action Alternative, would be enhanced under this alternative. The areas will likely be cleaned up more thoroughly and resilience activities will enhance stand recovery. Also, the speed of these activities and effects will help the sites recover the forested environment sooner.

It may become necessary to close off part or the entire site during implementation. All closures would be coordinated with the Forest Concession Permit Administrator, for sites operated by the concessionaire to minimize effects to the public and the permit holder. Forest Service operated sites would be coordinated on the local district. The public would be informed of the purpose of the closure, the anticipated duration of the closure and directed to alternative recreation opportunities in the vicinity. The closure/partial closure of a site would affect users due to the

additional personnel, machinery and noise on site and the loss of access to that particular developed recreational activity. As a result of past clearing projects in developed campgrounds, there may be an increase in travel trailers and motor homes; there also may be a decline in tent campers, most likely due to the reduced shade, increased wind and lack of privacy.

The removal of hazard trees and fuel loads would result in the mitigation of hazardous conditions and increased user safety within all treatment areas for the foreseeable future. Annual costs of assessing and treating hazard trees would be nearly eliminated, which would account for substantial savings for many years.

Another benefit that would be expected to result from a concerted effort to remove hazard trees would be that more roads, trails and developed recreation sites would consistently be open for public use following treatment.

Any implementation within developed recreation sites (trailheads, picnic areas, campgrounds) would follow the necessary parameters for felling and/or removing trees defined by the proposed Design Features. The Design Features aim to protect infrastructure and minimize potential ground surface damage caused by project implementation and provide for removing the appearance of a disturbed environment in the immediate vicinity of the sites.

Dispersed Recreation Sites, General Forest Area and Trails

Dispersed recreational sites may be directly or indirectly affected by implementation of the Proposed Action Alternative, depending on their proximity to each treatment area. Many dispersed campsites are directly adjacent to NFS roads, and those that fall within the treatment areas would potentially be temporarily affected by activities such as the sights and sounds associated with the operation of heavy equipment, as well as increased traffic and personnel. After the hazard trees would be removed, however, these sites would more than likely see an increase in use since sites outside of the proposed treatment areas would potentially be blocked by falling trees or become high risk areas due to the public safety issues caused by the remaining hazard trees. The closure of existing sites could have the additional consequence of the public creating new dispersed locations, resulting in altered traffic patterns and campsites. Dispersed sites in Management Areas 2A, 2B and 3A would be treated when treatments occur in the vicinity. Sites in other Management Areas may be treated to provide for public safety.

Trails

Clearing of hazard trees in the project area would improve the safety of the public who use the trails for hunting, fishing, wildlife viewing and other activities. By felling and removing hazard trees adjacent to roads and trails, long-term closures would be minimized and visitors would continue to be able to access these activities. During project implementation these trails and roadways associated with dispersed sites could temporarily be closed and would see an increase in logging traffic and personnel activity. These activities may temporarily displace potential users

of these sites and trails until the project is complete. Trails outside of treatment areas would continue to be treated on a case-by-case basis, which could lead to trail closures.

Snow trails for skiing and snowmobiling could be affected by winter operations. These activities are important to visitors, partner organizations and for local economies. Access roads will be affected by hauling activities. Ski trails may be affected by keeping roads open for timber activities. The skiing experience may also be affected by timber activities. It is important to address these impacts during treatment design. Effects to snow trails and access to them will be mitigated utilizing implementation criteria and through application of the design features.

Recreation Special Uses

Implementation of the Proposed Action Alternative could affect recreation residences, resorts, and organization camps and ski areas. This action would be expected to result in temporary negative effects at these facilities during project implementation since clearing would occur in close proximity to these facilities. These effects would potentially include the sights and sounds of machinery and other activities required during project implementation. While these effects would be temporary, the visual impact would occur in a shorter time-frame as the clearing would be immediate as opposed to intermittent removal of dead trees under the No Action Alternative. The design features will help to give a cleaner appearance to the areas surrounding these facilities.

Implementation of the Proposed Action Alternative would have less of an effect on special use permitted activities that do not require immobile structures. Outfitting and guiding and recreation events may be temporarily displaced during project implementation; however, these events can often be relocated to prevent potential conflicts. There would likely be some permitted activities that would be reduced or eliminated during project implementation. The short-term effects of this would be expected to be less of an impact to these operations in the long term than the continual natural falling of trees in special use permit areas.

Alternative 3 (Public Safety Focus) – Direct and Indirect Effects

Developed Recreation Areas

Implementation of Alternative 3 would result in positive safety effects similar to the Proposed Action at treated recreational sites and facilities, including: campgrounds, picnic areas, trailheads. The effect on existing recreational activities may range from closure of a developed campground for a week to an entire season while hazard trees are cut and removed from the treatment area.

Treatments in developed recreation sites would accelerate removal of hazard trees over the typical rate without treatments. Site will be less likely to be closed for multiple years as they would be when numerous hazard trees exist and the capability of removing them is left to normal capacity. The experience after treatment compared to treatment under normal capacity, as described in the No Action Alternative, would be enhanced under this alternative. The areas will likely be cleaned

up more thoroughly and resilience activities will enhance stand recovery. Also, the speed of these activities and effects will help the sites recover the forested environment sooner.

It may become necessary to close off part or the entire site during implementation. All closures would be coordinated with the Forest Concession Permit Administrator, for sites operated by the concessionaire to minimize effects to the public and the permit holder. Forest Service operated sites would be coordinated on the local district. The public would be informed of the purpose of the closure, the anticipated duration of the closure and directed to alternative recreation opportunities in the vicinity. The closure/partial closure of a site would affect users due to the additional personnel, machinery and noise on site and the loss of access to that particular developed recreational activity. As a result of past clearing projects in developed campgrounds, there may be an increase in travel trailers and motor homes; there also may be a decline in tent campers, most likely due to the reduced shade, increased wind and lack of privacy.

The removal of hazard trees and fuel loads would result in the mitigation of hazardous conditions and increased user safety within all treatment areas for the foreseeable future. Annual costs of assessing and treating hazard trees would be nearly eliminated, which would account for substantial savings for many years.

Another benefit that would be expected to result from a concerted effort to remove hazard trees would be that more roads, trails and developed recreation sites would consistently be open for public use following treatment.

Any implementation within developed recreation sites (trailheads, picnic areas, campgrounds) would follow the necessary parameters for felling and/or removing trees defined by the proposed Design Features. The Design Features aim to protect infrastructure and minimize potential ground surface damage caused by project implementation and provide for removing the appearance of a disturbed environment in the immediate vicinity of the sites.

Dispersed Recreation Sites, General Forest Area and Trails

Dispersed recreational sites may be directly or indirectly affected by implementation of Alternative 3, depending on their proximity to the project area. Many dispersed campsites are directly adjacent to NFS roads, and those that fall within the treatment areas would potentially be temporarily affected by activities such as the sights and sounds associated with the operation of heavy equipment, as well as increased traffic and personnel. After the hazard trees would be removed, however, these sites would more than likely see an increase in use since sites outside of the proposed treatment areas would potentially be blocked by falling trees or become high risk areas due to the public safety issues caused by the remaining hazard trees. The closure of existing sites could have the additional consequence of the public creating new dispersed locations, resulting in altered traffic patterns and campsites. Dispersed sites in Management Areas 2A, 2B

and 3A would be treated when treatments occur in the vicinity. Sites in other Management Areas may be treated to provide for public safety.

Trails

Under Alternative 3, it is less likely that there will be beneficial or negative effects to trails, due to the likelihood that fewer areas will be treated. The effects in treated areas will remain the same. Clearing of hazard trees in the project area would improve the safety of the public who use the trails for hunting, fishing, wildlife viewing and other activities. By felling and removing hazard trees adjacent to roads and trails, long-term closures would be minimized and visitors would continue to be able to access these activities. During project implementation these trails and roadways associated with dispersed sites could temporarily be closed and would see an increase in logging traffic and personnel activity. These activities may temporarily displace potential users of these sites and trails until the project is complete. Trails outside of treatment areas would continue to be treated on a case by case basis, which could lead to trail closures.

Snow trails for skiing and snowmobiling could be affected by winter operations. These activities are important to visitors, partner organizations and for local economies. Access roads will be affected by hauling activities. Ski trails may be affected by keeping roads open for timber activities. The skiing experience may also be affected by timber activities. It is important to address these impacts during project design. Effects to snow trails and access to them will be mitigated utilizing implementation criteria and through the design features.

Recreation Special Uses

Implementation of the Alternative 3 would be similar to the Proposed Action for effects at recreation residences, resorts, and organization camps and ski areas. This action would be expected to result in temporary negative effects at these facilities during project implementation since clearing would occur in close proximity to these facilities. These effects would potentially include the sights and sounds of machinery and other activities required during project implementation. While these effects would be temporary, the visual impact would occur in a shorter time-frame as the clearing would be immediate as opposed to intermittent removal of dead trees under the No Action Alternative. The design features will help to give a cleaner appearance to the areas surrounding these facilities.

Implementation of the Alternative 3 would have less of an effect on special use permitted activities that do not require immobile structures than in the Proposed Action. Outfitting and guiding and recreation events may be temporarily displaced during project implementation; however, these events can often be relocated to prevent potential conflicts. There would likely be some permitted activities that would be reduced or eliminated during project implementation. The short-term effects of this would be expected to be less of an impact to these operations in the long term than the continual natural falling of trees in special use permit areas.

Alternative 4 (Spruce Salvage) – Direct and Indirect Effects

Developed Recreation Areas

Implementation of Alternative 4 would result in positive safety effects similar at treated recreational sites and facilities, including: campgrounds, picnic areas, trailheads. It is less likely that treatments will occur in developed recreation sites. The effect on existing recreational activities may range from closure of a developed campground for a week to an entire season while hazard trees are cut and removed from the treatment area.

Treatments in developed recreation sites would accelerate removal of hazard trees over the typical rate without treatments. Site will be less likely to be closed for multiple years as they would be when numerous hazard trees exist and the capability of removing them is left to normal capacity. The experience after treatment compared to treatment under normal capacity, as described in the No Action Alternative, would be enhanced under this alternative. The areas will likely be cleaned up more thoroughly and resilience activities will enhance stand recovery. Also, the speed of these activities and effects will help the sites recover the forested environment sooner.

It may become necessary to close off part or the entire site during implementation. All closures would be coordinated with the Forest Concession Permit Administrator, for sites operated by the concessionaire to minimize effects to the public and the permit holder. Forest Service operated sites would be coordinated on the local district. The public would be informed of the purpose of the closure, the anticipated duration of the closure and directed to alternative recreation opportunities in the vicinity. The closure/partial closure of a site would affect users due to the additional personnel, machinery and noise on site and the loss of access to that particular developed recreational activity. As a result of past clearing projects in developed campgrounds, there may be an increase in travel trailers and motor homes; there also may be a decline in tent campers, most likely due to the reduced shade, increased wind and lack of privacy.

The removal of hazard trees and fuel loads would result in the mitigation of hazardous conditions and increased user safety within all treatment areas for the foreseeable future. Annual costs of assessing and treating hazard trees would be nearly eliminated, which would account for substantial savings for many years.

Another benefit that would be expected to result from a concerted effort to remove hazard trees would be that more roads, trails and developed recreation sites would consistently be open for public use following treatment.

Any implementation within developed recreation sites (trailheads, picnic areas, campgrounds) would follow the necessary parameters for felling and/or removing trees defined by the proposed Design Features. The Design Features aim to protect infrastructure and minimize potential ground surface damage caused by project implementation and provide for removing the appearance of a disturbed environment in the immediate vicinity of the sites.

Dispersed Recreation Sites, General Forest Area and Trails

Dispersed recreational sites may be directly or indirectly affected by implementation of Alternative 4, depending on their proximity to the project area. Many dispersed campsites are directly adjacent to NFS roads, and those that fall within the treatment areas would potentially be temporarily affected by activities such as the sights and sounds associated with the operation of heavy equipment, as well as increased traffic and personnel. After the hazard trees would be removed, however, these sites would more than likely see an increase in use since sites outside of the proposed treatment areas would potentially be blocked by falling trees or become high risk areas due to the public safety issues caused by the remaining hazard trees. The closure of existing sites could have the additional consequence of the public creating new dispersed locations, resulting in altered traffic patterns and campsites. Dispersed sites in Management Areas 2A, 2B and 3A would be treated when treatments occur in the vicinity. Sites in other Management Areas may be treated to provide for public safety.

Trails

Under Alternative 4, it is expected that similar or greater numbers of trails will be affected by treatment activities. Clearing of hazard trees in the project area would improve the safety of the public who use the trails for hunting, fishing, wildlife viewing and other activities. By felling and removing hazard trees adjacent to roads and trails, long-term closures would be minimized and visitors would continue to be able to access these activities. During project implementation these trails and roadways associated with dispersed sites could temporarily be closed and would see an increase in logging traffic and personnel activity. These activities may temporarily displace potential users of these sites and trails until the project is complete. Trails outside of treatment areas would continue to be treated on a case by case basis, which could lead to trail closures.

Snow trails for skiing and snowmobiling could be affected by winter operations. These activities are important to visitors, partner organizations and for local economies. Access roads will be affected by hauling activities. Ski trails may be affected by keeping roads open for timber activities. The skiing experience may also be affected by timber activities. It is important to address these impacts during project design. Effects to snow trails and access to them will be mitigated utilizing implementation criteria and through the design features.

Recreation Special Uses

Implementation of the Alternative 4 would likely be similar to the Proposed Action for effects at recreation residences, resorts, and organization camps and ski areas. This action would be expected to result in temporary negative effects at these facilities during project implementation since clearing would occur in close proximity to these facilities. These effects would potentially include the sights and sounds of machinery and other activities required during project implementation. While these effects would be temporary, the visual impact would occur in a shorter time-frame as the clearing would be immediate as opposed to intermittent removal of dead

trees under the No Action Alternative. The design features will help to give a cleaner appearance to the areas surrounding these facilities.

Implementation of the Alternative 4 would have likely have more of an effect on special use permitted activities that do not require immobile structures than in the Proposed Action. Outfitting and guiding and recreation events may be temporarily displaced during project implementation; however, these events can often be relocated to prevent potential conflicts. There would likely be some permitted activities that would be reduced or eliminated during project implementation. The short-term effects of this would be expected to be less of an impact to these operations in the long term than the continual natural falling of trees in special use permit areas.

Cumulative Effects Common to All Action Alternatives

Desirability of recreation opportunities may be reduced during active vegetation treatments where logging traffic, visual resources and trail opportunities are reduced. The action alternatives when combined with other vegetation treatments could reduce tree-related hazards to dispersed and developed recreation opportunities; however the combined treatments could impact visual landscapes at both the foreground and background that alter user experience either positively or negatively. Vegetation treatments could alter big game foraging and movement which may impact hunters. In the long-term combined vegetation treatments could result in more desirable forest conditions for motorized and non-motorized travel in the front-country, could improve conditions for hunting, site seeing (including vista points), and other developed and dispersed activities such as camping.

Scenic Quality and Visual Resources

This section discusses how scenic quality and visual resources within the GMUG National Forest may be affected by the proposed SBEADMR activities.

Compliance with Regulatory Direction

The revised 1991 Grand Mesa, Uncompahgre and Gunnison (GMUG) Forest Plan provides guidance for all resource management activities on National Forest lands. The Forest Plan includes standards and guidelines for the management of scenic resources in the Forest-wide Direction and Management Area Prescriptions.

The work completed under the EIS will be implemented and documented via a Pre-Treatment Checklist (Appendix C). As each new treatment area is identified, the site would be surveyed and the specific visual quality objectives for each area, valued scenic resources and sensitivity level for scenery will be identified. Design features for scenic resources would be selected accordingly (See Appendix B and Table 92, below).

Analysis Methodology

Landscape viewing is subdivided into distance zones. For the visual analysis these distance zones and their related concern levels are defined as:

- Immediate Foreground: 0 feet to 300 feet (concern level 1) – This area receives the highest scrutiny.
- Foreground: 300 feet to one-half mile (concern level 1) – In this area, individual forms dominate (for example individual trees) and other sensory messages are received (for example birds singing).
- Middleground: one-half mile to four miles (concern level 2) – In this area, form, texture, and color remain dominant; human activities (such as timber harvest) may cause contrasting features if there are vantage points.

Past, current and reasonably foreseeable activities were reviewed to extrapolate reasonable cumulative effects. The cumulative effects of the activities can be grouped into four categories. First, a number of projects propose no immediate physical changes to scenic resources. Second, many projects proposing new or expanded work on trails or recreation sites are too small in scale to have a significant effect on scenic resources, and occur in areas where some modification of the scenic resource is expected. Third, many projects are being implemented with the express purpose of rehabilitating forest lands, which would improve scenic resources. Fourth, all projects proposed and underway require analysis and will take scenic impacts into account before approval.

Affected Environment

The GMUG lies in the upper Colorado River Drainage and is located astride two distinct geographic areas; the Colorado Plateau and the Southern Rocky Mountains. The Colorado Plateau is characterized by high flat-top mountains and rolling plateaus, while the Southern Rocky Mountain region has rugged mountains and valleys, steep slopes and dramatic changes in elevation. The vegetation types include many species of aspen, pine and fir, as well as grasslands and alpine meadows.

The characteristic landscapes of this forest are steep mountain lands and rolling plateau lands. The foreground and mid-ground are defined by the fine vegetative texture or stands of trees and meadows and color in the spring (wildflowers) and fall (fall color), with openings in forest cover revealing dramatic landforms in the background. There are many areas with distinctive scenery, including waterfalls, narrow canyons and meadows full of wildflowers. Long views would tend to be finely textured views of common scenery. Scenery is framed by backgrounds featuring steep, often snow-capped mountains and unique geological formations.

There is significant evidence of beetle-killed and SAD-impacted stands throughout the forest. Because scenic views in the forest often encompass great distances over forested landscapes, beetle-killed and SAD-impacted stands can have a significant negative impact on scenic resources and landscape character.

Past, present and future management activities within the GMUG National Forests were reviewed for cumulative effects on scenic resources. The landscape characteristics remain in place with some changes resulting from natural events such as wildfires, winds, insects and disease; and human activities such as timber cutting, roads, trails, dispersed and developed recreation, mining, ranch/cabin developments, utilities, and livestock grazing and development.

Alternative 1 (No Action) – Direct and Indirect Effects

Under Alternative 1, the No Action Alternative, no acres would be treated under the SBEADMR project, although smaller recovery, resiliency, and hazard tree removal projects would continue to be implemented under existing authorizations. Natural events and human activities would continue to change the scenic landscapes. Developed campgrounds and picnic grounds would continue to have hazardous trees cut and removed to meet the public safety requirement (FSM 2332.11 Public Safety, Hazard Trees), but to a lesser extent and over a longer time period of implementation. Most standing dead and dying trees would remain standing up to approximately a decade and would therefore remain a hazard to forest users and travelers until removed or blown down. Strong winds could blow down dead and dying trees across trails and roads, campsites, trailhead parking areas and administrative sites. Trees falling naturally across Forest Service roads or forest trails would be cut to open access through travelways as required by the Highway Safety Act of 1966 and FSM 7733. Downed trees that were cut to open travelways would not be removed. The evidence of cut ends of logs, when viewed from the immediate foreground of travelways, would impact scenic quality. In certain areas, visitors would notice high numbers of downed trees in or near travel corridors and recreation areas, which would negatively impact scenery.

Indirect effects to scenic quality include impacts from travelers avoiding downed trees and the continuing increase of dead and dying trees. Travelers could impact the immediate foreground of scenic resources by creating new paths around roads or trails blocked by naturally fallen trees that have not yet been removed by the Forest Service. Impacts could include eroded or bare soils; trampled or removed ground-level vegetation along created paths; and damage to young healthy trees.

In addition, the rate of spruce mortality from the spruce beetle epidemic continues to increase. Associated scenic impacts from spruce beetle will continue to increase, and there will be continued scenic impacts from sudden aspen decline (SAD), resulting in a long-term decline of the scenic resource.

Alternative 1 (No Action) – Cumulative Effects

There are no proposed management activities under Alternative 1. Therefore, no changes to scenic quality will result from the implementation No Action Alternative. The direct and indirect effects of natural processes in combination with past, on-going, and future activities could result in cumulative effects to scenic quality. Given reasonable foreseeable vegetation management,

fewer areas would be treated, leaving more visible dead and downed stands on the landscape for the long-term.

Effects Common to All Action Alternatives

The following design features are applicable to all action alternatives.

Table 92. Design Features for Scenic Quality and Visual Resources.

Design Feature	Trigger for Use	Description	Effect
SVR-1	In developed recreation sites, including trailheads and administrative sites (typically Visual Quality Objectives [VQOs] of Modification or Maximum Modification)	Cut stumps as low to the ground as feasible. Remove or chip slash at developed campgrounds or designated recreation areas, extending outwards 200 feet of any constructed feature; at designated dispersed sites; and other dispersed sites deemed important at the time of implementation. Alternatively, at designated dispersed sites or other dispersed sites deemed important and at developed recreation sites (except developed campgrounds or designated recreation areas) and at administrative sites, move heavy slash to designated slash piles and burn as soon as conditions allow. Note: designated recreation areas include but are not limited to: Taylor Canyon, Mesa Lakes, Island Lake, and Amphitheatre/Na-Gach.	Limit immediate and longer-term visual impact of treatments
SVR-2	In developed recreation and administrative sites (typically VQOs of Modification or Maximum Modification)	Minimize damage from mechanical treatments to young healthy trees and understory trees and shrubs.	Provide present and future shade and screening, and to maintain high quality recreational setting and desired scenic condition.
SVR-3	In areas with VQOs of Pristine or Preservation,	Where feasible, fresh cut ends of logs that are felled, but not removed, will be moved away from the trail. When cutting trees that fall across trails or within the trail corridor (generally 3 feet on either side of the trail), lop and scatter logs and limbs outside the corridor and remove heavy slash in the foreground and mid-ground (approximately 300 feet from edges) of roads and trails.	Reduce visual evidence of management activities, such that they repeat form, line, color and texture which are frequently found in the characteristic landscape.
SVR-4	In areas with VQOs of Retention or Partial Retention	In areas of Retention or Partial Retention, minimize damage to natural features such as rock outcrops, young healthy trees and understory of trees and shrubs; cut stumps as low to the ground as feasible. Note: Retention and Partial Retention should be applied to National Recreation Trails, National Scenic Trails, National Historic Trails and State or Forest Service	

Design Feature	Trigger for Use	Description	Effect
		Scenic Byways/All-American Roads.	
SVR-5	All treatments	Revegetate and till disturbed and compacted soils on landings, burned slash pile sites, skid trails and temporary roads with native seed mixture after the completion of treatments. Block access to decommissioned roads with naturalistic barriers.	Reduce soil contrast and encourage regrowth.
SVR-6	All designated trails (NRT, NST and NHT) and scenic byways	Remove heavy slash within the immediate foreground (not less than 25 feet from edges of roads and trails) to slash piles or chip.	Reduce visual evidence of management activities, such that they repeat form, line, color and texture which are frequently found in the characteristic landscape.

Alternative 2 (Proposed Action) – Direct and Indirect Effects

The direct effect of the Proposed Action on scenic quality would be that, in treated areas, forest visitors would notice the removal of mature trees that once dominated the forest landscape. The immediate visual impact from resilience treatments may be negative, depending on the value of the observer for more or less dense stand settings. Openings resulting from removal of live and diseased trees of various sizes and shapes would be noticed by visitors traveling along road and trail corridors and in campsites. The immediate visual impact from recovery treatments may be positive, as the removal of dead and dying trees may be considered an improvement upon the status quo. Fewer large stands of dead trees would be visible from travelways, potentially improving scenic quality.

Negative short-term impacts on scenic resources would occur from temporary roads and along existing corridors from mechanical management activities. In the short-term, mechanical treatments would be more apparent to visitors traveling through active work areas. Some felled trees would remain on the ground to protect sensitive plants, hydric soils and wildlife habitat in identified sites. Some sections of trail corridors would have large amounts of felled trees visible on the ground by trail users, which could negatively impact scenery. Some trees would remain to provide present and future shade and screening. Some administrative sites may become more visible due to removal of screening trees.

Removing dead and diseased trees in affected spruce stands via recovery treatments would allow existing advanced regeneration to grow faster with less competition for light and moisture, which would improve scenic quality over the long-term.

Replanting in recovery-treated areas with no seed source or existing advanced regeneration would, in the long-term, recover a forested condition that would most closely approximate previous scenic qualities, in comparison to the likelihood that such areas would have otherwise converted to shrub and grasses.

Some larger treated sites may have adjacent green trees with shallow root systems. These trees may be naturally blown down by strong winds, causing downed trees with exposed roots to dominate the openings and lower the scenic integrity when viewed from recreation areas and scenic corridors. However, silvicultural prescriptions (Appendix A) are designed to limit the likelihood of blowdown post-treatment. Depending on the structural stand condition, prescriptions require maintenance of 60% of the original stocking in a treatment area or limit treatments to patch cuts of less than 3 tree lengths in size (.25 to 2 acre openings).

Resiliency treatments in spruce would, over the long-term, result in a more heterogeneous, multi-storied stand condition and maintenance of the spruce-fir vegetation type. Associated indirect impacts to scenic quality may include persistence of the vegetation type currently associated with the area, with a greater likelihood to persist throughout future stressors with less visible mortality.

Alternatives 2 (Proposed Action) and 4 (Spruce Salvage) – Cumulative Effects

Alternatives 2 and 4 would implement felling and/or removal of dead and dying trees. Some short-term negative scenic impacts would occur due to mechanical treatments and impacts along existing and temporary roads. The cumulative effects of these actions, combined with other related actions involving felling and/or removal of dead, dying and green trees, would be short-term negative impacts to the immediate foreground and foreground due to evidence of mechanical treatment. But for some observers, this would lead to a longer-term increase in scenic quality over existing conditions, promoting quicker regeneration of new trees within travelways and recreation areas. Across the landscape of the GMUG, however, only a maximum of 4% is proposed for actual treatment in the 8-12 year implementation timeframe, so the scale of such visual impacts would be limited. The action would not cause any long-term adverse cumulative effects to the scenic resource. Vegetation treatments on the forest conform to the VQO's and proposed treatments must be reviewed in conjunction with surrounding treatments at the time of project design to minimize impacts on visual resources.

Alternative 3 (Public Safety Focus) – Direct and Indirect Effects

The direct effect of Alternative 3 on scenic quality are similar to those from the Proposed Action, but would be limited to areas within the WUI and road corridors. Concentrating the effects into a smaller geographic area, and one that is inherently populated, would increase the likelihood of the identified positive and negative impacts to scenic quality being more readily observed. However, the WUI is by nature a more developed environment with fewer continuous and dense expanses of vegetation, so the visual contrast of most treatments would not be as remarkable as in other alternatives.

Outside the WUI and road corridors, natural events and human activities would continue to change the scenic landscapes. There would be less removal or felling of standing dead and dying trees (except hazard trees), and such trees would remain standing for approximately a decade. These could be a hazard to forest users and travelers and block trails and roads, campsites, and trailhead parking areas. Downed trees blocking roads or trails would be cut by Forest Service workers or contractors to open access as required by the Highway Safety Act of 1966 and FSM 7733. These trees would not be removed and would impact scenic quality due to the evidence of cut ends of logs when viewed from the immediate foreground of travelways.

Indirect effects would be the same as described in the Proposed Action, but would concentrate the effects into a smaller geographic area, and one that is inherently populated. Both factors would increase the likelihood of the identified positive and negative impacts to scenic quality being more readily observed.

Alternative 3 (Public Safety Focus) – Cumulative Effects

The cumulative effects of Alternative 3 are the same as described in the Proposed Action, but would be limited geographically to the WUI and road corridors. Impacts would be more concentrated.

Alternative 4 (Spruce Salvage) – Direct and Indirect Effects

The direct effect of Alternative 4 on scenic quality are similar to those described in the Proposed Action and Alternative 3, except there would be no visual impacts in green spruce stands. More dead and dying stands would be harvested, perhaps leading to greater increase in scenic quality over the status quo in comparison to the other alternatives.

Indirect effects from Alternative 4 are the same as those described for the Proposed Action and Alternative 3, but would be limited to only those accruing from recovery treatments.

Forest Plan Compliance

The various action alternatives would comply with the adopted visual quality objectives when the design features for scenic resources are followed. Trail sections with a large amount of cut trees left on the ground and visible when viewed from nearby trails would appear as Modification or Maximum Modification VQO instead of Retention or Partial Retention VQO. Sections of road corridors where heavy felling and removal of dead and dying trees would occur would appear as Modification VQO instead of Partial Retention VQO.

There would be no irreversible or irretrievable negative effects on scenic resources due to any action alternative.

Short-term Uses and Long-term Productivity

NEPA requires consideration of "the relationship between short-term uses of man's environment and the maintenance and enhancement of long-term productivity" (40 CFR 1502.16). As declared by the Congress, this includes using all practicable means and measures, including financial and technical assistance, in a manner calculated to foster and promote the general welfare, to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans (NEPA Section 101).

These relationships between short-term uses and long-term productivity are addressed in the effects sections for each resource. In this project, design features incorporated into all action alternatives, the Pre-Treatment Checklist – including documentation of Forest Plan compliance, Annual Treatment Review, and the Adaptive Implementation framework for incorporating information from emerging science and monitoring will ensure that the long-term productivity of the land is not impaired by short-term uses.

Unavoidable Adverse Effects

The following is a description of adverse effects that are unavoidable with implementation of action alternatives. For further discussion of the effects on the resources listed below, see Chapter 3 under the respective resource topics.

Silviculture resources would continue to be impacted by spruce beetle and SAD.

Wildlife habitat for certain species would be adversely affected to varying levels with implementation of the action alternatives. The Wildlife section of Chapter 3 discloses those effects.

Air quality would be adversely affected on a temporary/seasonal basis as a result of planned burning of hand/equipment piles and dust from roads and activities.

Scenic quality would be affected adversely for some observers by the treatments; scenic resources for some observers would continue to be impacted by visual evidence of spruce beetle and SAD on the landscape.

Surface fuel loadings could increase if a particular treatment prescription does not include treatment of those fuels. This would generally only occur outside WUI where slash is desired to improve regeneration success (i.e., create microsites).

Soils can be eroded wherever vegetation and soils are disturbed. Compaction can occur where vehicles and equipment are used.

Heritage resources can be disturbed or destroyed where human or natural activities take place; however, all eligible or listed cultural resources will be avoided in the implementation of this project.

Botany resources can be adversely affected by treatments such as timber harvest, prescribed fire and road building which can ultimately affect the overall capacity of the species to persist as an individual plant, as a single population, or as a group of populations in a local area.

Irreversible and Irretrievable Commitments of Resources

Irreversible commitments of resources are those that cannot be regained, such as the extinction of a species or the removal of mined ore. Irretrievable commitments are those that are lost for a period of time such as the temporary loss of timber productivity in forested areas that are kept clear for use as a power line rights-of-way or road.

There are not **irreversible** commitments of resources with any of the alternatives analyzed.

Irretrievable commitments of resources are discussed under the effects sections in Chapter 3. Key **irretrievable** commitments of resources include the following:

Soil productivity and timber productivity is lost in the near and medium-term where road construction is planned in all action alternatives.

Air quality would be temporarily impacted to varying degrees by smoke generated from burning hand/equipment piles and by dust from road use resulting from implementation of the action alternatives.

Wildlife habitat loss or modification for certain wildlife species is likely under all alternatives. As vegetation recovers, habitat would eventually return over various periods depending on treatment/disturbance amount. There will be some treatment in lynx habitat, which will result in some lynx habitat loss until vegetation regenerates, however, these losses will stay within allowable impacts in accordance with the Southern Rockies Lynx Amendment. The maximum number of acres of lynx habitat which may be lost or modified by treatment is discussed in further detail in the Wildlife section of Chapter 3.

Other Required Disclosures

NEPA at 40 CFR 1502.25(a) directs "to the fullest extent possible, agencies shall prepare draft environmental impact statements concurrently with and integrated with …other environmental review laws and executive orders." Other laws, policy and executive orders which are integrated into this project are outlined in Chapter 1, in the Management Direction and Strategy section.

Specific laws pertaining to particular resource areas are outlined in Chapter 3 under the respective resource areas.

CHAPTER 4. LIST OF PREPARERS, CONSULTATION AND COORDINATION

A. PREPARERS

The following people participated in initial internal scoping, were members of the Interdisciplinary Team, and/or provided direction and assistance during the preparation of this DEIS.

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Scott Williams	Fire Management Specialist

Interdisciplinary Team

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Mary Johnson	Administrative Assistant – Mailing List Manager
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B. GOVERNMENT AGENCIES AND TRIBAL GOVERNMENTS CONTACTED

FEDERAL GOVERNMENT

U.S. Environmental Protection Agency, Region 8
U.S. Fish and Wildlife Service
U.S. Department of Energy, Western Area Power Administration
Federal Aviation Administration, Northwestern and South Pacific Divisions
U.S. Army Corps of Engineers
U.S. Federal Highway Administration, Colorado Division
Department of Interior, Office of Environmental Policy and Compliance
Department of Agriculture, Natural Resources Conservation Service

TRIBAL GOVERNMENT

Southern Ute Indian Tribe
Ute Tribe of the Unitah and Ouray Reservation
The Hopi Tribe

Acoma Pueblo
Pueblo of Zia
Zuni Tribe of the Zuni Reservation

STATE GOVERNMENT

Colorado Department of Transportation
Colorado State Historic Preservation Office
Colorado Parks and Wildlife, Division of Wildlife
Colorado State Division of Water Resources, Water Division No. 5
Colorado Air Pollution Control Division
Colorado Water Conservation Board
Colorado Division of Water Resources
Colorado State Forest Service
Colorado Department of Public Health and Environment

LOCAL GOVERNMENT

Board of Commissioners:

- Montrose County
- San Miguel County
- Mesa County
- Hinsdale County
- Saguache County
- Gunnison County
- Ouray County
- Delta County

Town of:

- Orchard City
- Crawford
- Cedaredge
- Hotchkiss
- Grand Junction
- Fruita
- Paonia
- Palisade
- Collbran

C. INDIVIDUALS AND ORGANIZATIONS WHO COMMENTED DURING AND AFTER FORMAL SCOPING

The announcement regarding the availability of the DEIS for public comment will also be sent to all attendees of public meetings who provided contact information. Copies of public meeting sign-in sheets are available in the project file.

Scoping Commenters – Individuals (NOTE: Many people listed below were signatories to organization comment letters.)

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James Stafford

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Steven Webber
Stan Whinnery
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Scoping Commenters - Organizations

Mesa County Board of County Commissioners

Delta County Board of County Commissioners

Director, USEPA Region 8, NEPA Compliance and Review Program

Sheep Mountain Alliance
Hinsdale County Board of Commissioners
Montrose County Board of Commissioners
Colorado Timber Issue Coordinator
Uncompahgre Habitat Watchman
Backcountry Hunters and Anglers
Hopi Tribe
Rocky Mountain Recreation Initiative
Montrose Forest Products, LLC
High Country Citizens' Alliance
Southern Ute Indian Tribe

Western Slope Conservation Center
Intermountain Forest Association
Western Colorado Congress
Colorado Parks and Wildlife

U.S. Department of Energy, Western Area Power Administration

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Matt Sandler
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Post Scoping Commenters - Organizations

Western Colorado Congress
Sheep Mountain Alliance
Colorado Timber Industry Association
Rural Resource Solutions
Montrose Forest Products
Montrose County Board of County Commissioners
Habitat Watchman
High Country Conservation Advocates
Wilderness Workshop
Conservation Colorado
Rocky Mountain Wild
Sierra Club, Rocky Mountain Chapter
Rocky Mountain Recreation Initiative
Wild Connections
San Juan Citizens Alliance
San Luis Valley Ecosystem Council
Quiet Use Coalition

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GLOSSARY

Abiotic. "The nonliving components of the environment, such as air, rocks, soil, water, coal, peat, plant litter, etc." (Thomas 1979).

Administrative NFS Road. Any NFS road that is not a public road.

Air Quality Related Value (AQRV). A scenic, cultural, physical, biological, ecological, or recreational resource on federal lands which may be affected by a change in air quality as defined by the Federal Land Manager (FLM).

Alkaline. "Material that is basic rather than acidic; having a pH greater than 7.0 (Harris and Harris 2001).

Allelopathy. A biological phenomenon by which an organism produces one or more biochemicals that influence the growth, survival, and reproduction of other organisms (en.wikipedia.org).

Alluvial. "Pertaining to material or processes associated with transportation or…deposition by concentrated running water" (USDA National Resources Conservation Service 2014).

Alpine. "Those portions of mountains that rise above the cold limits of trees" (Daubenmire 1978).

Alpine Zone. "The treeless alpine tundra, sometimes divided into low alpine, alpine, and high alpine zones, of which the last may correspond to what is called the 'nival' zone which hardly supports any vegetation except lichens" (Löve 1970).

Annual. "Enduring for not more than a year. A plant which completes its entire life cycle from germinating seedling to seed production and death within a year" (Dayton 1950). Often difficult to distinguish in some cases from biennial or monocarpic.

Aquatic. "Of or pertaining to water; growing in water. A plant or animal inhabiting water" (Dayton 1950), often exclusively.

Aquatic Ecosystem. The distinctive ecosystem dominated by water, aquatic plants, or aquatic animals. Usually the substrate for plant and microorganism growth is water, not soil in the usual sense. Distinct from the riparian ecosystem, which is a terrestrial ecosystem, and water-dependent but where the substrate is soil. In the aquatic ecosystem, producers include phytoplanktonic algae, and autotrophic consumers include crustaceans, rotifers, and fish. Heterotrophic consumers include benthic insects, mollusks, and crustaceans (Odum 1971:19). See terrestrial ecosystem and riparian ecosystem.

Archaeological Sites. Archaeological sites are a type of cultural resource consisting of the surface and/or buried remains of past human activity, typically present are artifacts and/or features of that activity or the tools and mechanisms for such use.

Area of Potential Effects (APE). The Area of Potential Effects (APE) is defined in the regulations implementing the Section 106 review process as "The geographic area or areas within

which an undertaking may directly or indirectly cause changes in the character or use of historic properties, if any such properties exist. The area of potential effects is influenced by the scale and nature of an undertaking and may be different for different kinds of effects caused by the undertaking." [36 CFR Part 800.16(d)].

Argillaceous. "Clayey; of or pertaining to plants growing on clay soils" (Harris and Harris 2001).

Aspen clone. Analogous to aspen 'stand' and aspen 'community'. Unique habitat occupied by aspen (*Populous tremuloides).*

Aspen mix. Areas where aspen is dominant, but species other than spruce and aspen may be present.

Aspen/Spruce mix. Areas where aspen and spruce are co-dominant.

Bankfull. Elevation of stream bank where flooding begins.

Basal Area (BA) – See Appendix B, this document for explanation; the cross-sectional area of all stems in a stand measured at breast height (4.5 feet) and expressed per unit of land area, generally square feet per acre.

Biennial. "A plant that completes its life cycle within two years, producing only vegetative growth in the first year, and flowering in the second" (Hickey and King 2000).

Biota. The combined plants and animals of a region.

Bog. "A wetland comprised of in-situ accumulations of poorly to moderately decomposed peats that are derived chiefly from sphagnum mosses. The water is acidic" (Helm and others 1985). "Sphagnum moss-dominated communities whose only water source is rainwater. They are extremely low in nutrients, form acidic peats, and are a northern phenomenon generally associated with low temperatures and short growing seasons;" hydrology is ombotrophic, trophic state is mostly oligotrophic (Mitsch and Gosselink 1986:24,261). Also see "fen."

Browse. "Twigs and shoots, with their leaves, cropped by livestock [or wildlife] from shrubs, trees, and woody vines" (Dayton 1950). "The parts of shrubs, woody vine, and trees available for animal consumption" (Artz and others 1983).

Caespitose. Sometimes spelled cespitose. "Tufted: having the stems in a tuft, as a bunch grass" (Dayton 1950).

Canopy Cover. "The area of ground surface included in a vertical projection of individual plant canopies" (coverage in Daubenmire 1978). The relative size of a polygon formed by the outer edges of the canopy of all plants of a given species (see Smith and others 1995). Canopy cover is usually expressed as a percentage, independently estimated for each plant species and for several non-species categories (bare soil, litter, rock, gravel, lichen, moss, etc.). The sum of canopy cover for all species in a plant community will be other than 100% in most, if not all, cases. See Daubenmire (1959) for a complete description of the concept. For mature trees, canopy cover is a synonym for crown cover; but canopy cover applies to all plant species, whether woody,

herbaceous, or cryptogamic, and also to non-species categories such as bare soil, litter, rock, and gravel.

Caudex. "The stem of a plant, usually a fern or a woody monocotyledon" (Hickey and King 2000)

Class I Area. Geographic area designated for the most stringent degree of protection from future degradation of air quality. The Clean Air Act designates as mandatory class I areas each national park over 6,000 acres and each national wilderness over 5,000 acres that existed as of the date of enactment (August 7, 1977).

Class II Area. These areas require somewhat less stringent protection from air pollution damage than Class I areas. All Forest Service managed lands that are not Class I areas are Class II areas.

Clearcut (clearcutting; clearfell) – removal of the entire stand in one cutting with reproduction obtained artificially or from seeds germinating after the clearing operation.

Clone. "An organism derived by sexual reproduction from a single parent; such organisms are therefore of the same genetic constitution" (Pritchard and others 1982). Examples in our include aspen, kinnikinnick, and Gambel oak.

Closure. Restriction of motor vehicle use on a travelway by means of elimination or prohibition. Closures may be permanent or temporary depending on management objectives.

Commercial Mechanical Treatment. Ground-based mechanized timber cutting on lands suitable for timber harvest as defined in the 1991 LRMP (Appendix F) and that produces a commercial product.

Common Stand Exams (CSE). Inventory plots installed to collect stand data and information.

Conifer. A tree that bears cones, in our area, the spruces (*Picea*), firs (*Abies*), Douglas-fir (*Pseudotsuga*), pines (*Pinus*), and juniper (*Juniperus*). Some botanists would not include juniper trees (for example, Dayton 1950).

Cultural Resources. Cultural Resources in this analysis consist of the significant archaeological and historical sites or structures left behind by Native American or Euro-American/other past occupation of an area. By law (National Historic Preservation Act-1966), such sites are at least 50 years old and have been determined to be significant and eligible for listing on the National Register (NR) of Historic Places as defined in 36 CFR 60. In general, these sites may be valued either for their association with history, Native American culture, or for their scientific research potential.

Culturally scarred trees (CSTs). CSTs are Ponderosa pines that have been determined to have been harvested (scarred) in prehistoric and proto-historic times to extract cambium for use as a food source by Native American populations.

Danger Tree. A standing tree that presents a hazard to people due to conditions such as deterioration of or damage to the root system, trunk, stem, or limbs or the direction or lean of the tree. *Synonymous with **hazard tree** for purposes of this Project.*

Deciduous. . "Falling away; not persistent or evergreen. Said of leaves that drop off in autumn," and also of plant species that have such leaves (Dayton 1950).

Decommissioning. Activities that result in the stabilization and restoration of unneeded roads or trails to a more natural state.

Decumbent. "Reclining on the ground but with the end ascending; bending horizontally at the base" (Dayton 1950).

Dendroglyphs. Any of various pictures, letters or symbols carved into tree boles and trunks by people in historic times. For the SBEADMR analysis, these typically refer to carved Aspen trees and associated often with sheepherding (Basque and other ethnic groups).

Designated road, trail, or area. A National Forest System road, a National Forest System trail, or an area on National Forest System lands that is designated for motor vehicle use pursuant to 36 CFR 212.51 on a motor vehicle use map.

Diameter @ Breast Height (DBH) – height at which tree diameter is normally measured specified as 4.5 feet above ground base of the tree.

Disturbance. "An event that causes a significant change from the normal pattern in an ecological system" (Forman and Godron 1986). Often subdivided into natural disturbances and man-caused disturbances. "Natural disturbances, such as drought, wild fires, grazing by native fauna, and insects are inherent in the development of any natural plant community," and in fact a natural plant community may be dependent on one or more of those disturbances.

Dominance. "The collective size or bulk of the individuals of a group of organisms [especially a species] as it determines their relative influence on other components of the ecosystem" (Daubenmire 1978). A plant species that is highly dominant on a site affects other components of the ecosystem to a greater extent than do other species, and the highly dominant species is a better expression of the local climate and site potential. Therefore, the relative dominance of plant species is of paramount importance for assessing the ecological potentials and management responses of a site. The best measure of dominance is canopy cover by species (Daubenmire 1968).

Ecosystem. A community of interacting organisms, considered together with the habitats and environments associated with the individuals and species of that community (after definitions of ecosystem and community in Daubenmire 1978).

Edaphic. "Due to, or pertaining to, the soil" (Harris and Harris 2001).

Ephemeral stream. A stream that flows only briefly and in response to a period of local rainfall.

Ethnographic Sites. A type of cultural resource: Locations where past use by Native American populations has been documented through the collection of oral histories, ethnographic interviews or broad culture area studies.

Evapotranspiration. Loss of water from the soil by evaporation and by transpiration from plants.

Evergreen. "Retaining most of its leaves throughout the year" (Hickey and King 2000).

Federal Land Manager (FLM). The Secretary of the Department with authority over such lands. (40 CFR 51.166(b)(24)). The FLM for the Forest Service has been delegated to the Regional Forester or individual Forest Supervisor.

Field Sampled Vegetation (FSVeg) stores data about trees, fuels, down woody material, surface cover, and understory vegetation. FSVeg supports the business of common stand exam, fuels data collection, permanent grid inventories, and other vegetation inventory collection processes. http://www.fs.fed.us/nrm/fsveg/

Fen. Low land that is covered wholly or partially with water, fed by groundwater, and has peaty alkaline soil.

Fern-Ally. "A member of the groups of fork ferns, club mosses, quillworts, or horsetails; classes of flowerless plants with usually small leaves" (Hickey and King 2000)

Flora. "The plant population of a particular region; a book listing and describing the plants found in a given area" (Hickey and King 2000).

Forb. "Forb is a term that has been coined by Dr. F. E. Clements to designate [herbaceous] flowering plants other than grasses and grasslike plants…" (Hanson 1929). Usually includes ferns and fern-allies, technically not flowering plants.

Forblands. "A community dominated by forbs" (Penfound 1967).

Forest road or trail. A road or trail wholly or partly within or adjacent to and serving the National Forest System that the Forest Service determines is necessary for the protection, administration, and utilization of the National Forest System and the use and development of its resources.

Forest transportation atlas. A display of the system of roads, trails, and airfields of an administrative unit.

Forest transportation system. The system of National Forest System roads, National Forest System trails, and airfields on National Forest System lands.

Fuelwood – material collected that is utilized for burning.

Functional class (roads). The grouping of roads by the character of service they provide.

> **Arterial road**. An NFS road that provides service to large land areas and usually connects with other arterial roads or public highways.
>
> **Collector road**. An NFS road that serves smaller areas than an arterial road and that usually connects arterial roads to local roads or terminal facilities. Provides service to smaller land

areas than an arterial road. It usually connects forest arterial roads to local forest roads or terminal facilities.

Local road. An NFS road that connects a terminal facility with collector roads, arterial roads, or public highways and that usually serves a single purpose involving intermittent use.

Gametophyte. "The sexual stage in the life cycle of a plant when the chromosomes in each cell are reduced to half the number, typically diploid reduced to haploid" (Hickey and King 2000).

Geophyte. "An herbaceous plant that perenniates by means of underground buds, e. g., bulbs, corms, rhizomes, etc." (Hickey and King 2000).

Graminoid. An herbaceous plant of one of three families: Grass (Poaceae), Sedge (Cyperaceae) or Rush (Juncaceae). Grasses and grasslike plants.

Grass. Plants and species belonging to the grass family (Poaceae, also called Gramineae).

Grassland. Land on which the dominant vegetation is comprised of grasses or grasslike plants (after Penfound 1967).

Habitat. The place where a plant or animal (individual, population, or species) lives. The biotic or abiotic environment of a plant, animal, or community. The study of habitat largely comprises the field of synecology, along with the relationship of habitat to community and ecosystem. Some ecologists would use the term habitat as a synonym for what we call site; such use is discouraged as confusing a species' (or population's) habitat with the area that it occupies. Habitat includes the concept of area covered by the species or population, but includes also much more, for example, structure and features contained within that area.

Hazard Tree. See **Danger tree** definition above.

Haze. An atmospheric aerosol of sufficient concentration to be visible. The particles are so small that they cannot be seen individually, but are still effective attenuating light and reducing visual range.

Herbaceous Plant (Herb). A non-woody flowering plant, with no persistent woody stem above ground. Sometimes taken to include ferns and fern-allies as well (see Penfound 1967).

Herbarium. "A collection of dried plants or parts of plants, usually mounted on sheets of thick paper, kept for the purposes of reference or research" (Hickey and King 2000).

Herbivore. "A plant-eating animal" (Pritchard and others 1982).

Historic Sites. A type of cultural resource: Locations, sites and structures dating from the historic period of an area, in the SBEADMR analysis this would be defined as 1801 to 1964 C.E. (common era, also formerly denoted as A.D.)

Individual tree selection (free thinning) – removal of individual trees based on project objectives.

Intermittent stream. A stream that flows seasonally.

Invertebrate. An animal without a backbone.

Limit of Acceptable Change (LAC). The amount of change that could occur without significantly altering an AQRV or sensitive receptor.

Lithic Scatters. A type of archaeological site; they are concentrations of stone tool manufacturing debris, utilized, broken and fully formed stone tools representing short and long term camps and limited activity sites.

Loam. Soil composed of a mixture of sand, clay, silt, and organic matter.

Macrobotanical Remains. Plant remains recovered from archaeological contexts that can be seen with the naked eye. These tend to be seeds and wood fragments, but nuts and other fruits may also be represented.

Macroinvertebrates. An invertebrate that is large enough to be seen without the use of a microscope.

Maintenance. The upkeep of the entire forest transportation facility including surface and shoulders, parking and side areas, structures, and such traffic-control devices as are necessary for its safe and efficient utilization.

Maintenance Levels (roads). Defines the level of service provided by, and maintenance required for, a specific road, consistent with road management objectives and maintenance criteria.

> **LEVEL 1.** These are roads that have been placed in storage between intermittent uses. The period of storage must exceed 1 year. Basic custodial maintenance is performed to prevent damage to adjacent resources and to perpetuate the road for future resource management needs. Emphasis is normally given to maintaining drainage facilities and runoff patterns. Planned road deterioration may occur at this level. Appropriate traffic management strategies are "prohibit" and "eliminate" all traffic. These roads are not shown on motor vehicle use maps.
>
> Roads receiving level 1 maintenance may be of any type, class, or construction standard, and may be managed at any other maintenance level during the time they are open for traffic. However, while being maintained at level 1, they are closed to vehicular traffic but may be available and suitable for nonmotorized uses.
>
> **LEVEL 2.** Assigned to roads open for use by high clearance vehicles. Passenger car traffic, user comfort, and user convenience are not considerations. Warning signs and traffic control devices are not provided with the exception that some signing, such as W-18-1 “No Traffic Signs,” may be posted at intersections. Motorists should have no expectations of being alerted to potential hazards while driving these roads. Traffic is normally minor, usually consisting of one or a combination of administrative, permitted, dispersed recreation, or other specialized uses. Log haul may occur at this level. Appropriate traffic management strategies are either to:

a. Discourage or prohibit passenger cars, or

b. Accept or discourage high clearance vehicles.

LEVEL 3. Assigned to roads open and maintained for travel by a prudent driver in a standard passenger car. User comfort and convenience are not considered priorities. The Manual on Uniform Traffic Control Devices (MUTCD) is applicable. Warning signs and traffic control devices are provided to alert motorists of situations that may violate expectations.

Roads in this maintenance level are typically low speed with single lanes and turnouts. Appropriate traffic management strategies are either "encourage" or "accept." "Discourage" or "prohibit" strategies may be employed for certain classes of vehicles or users.

LEVEL 4. Assigned to roads that provide a moderate degree of user comfort and convenience at moderate travel speeds. Most roads are double lane and aggregate surfaced. However, some roads may be single lane. Some roads may be paved and/or dust abated. Manual on Uniform Traffic Control Devices is applicable. The most appropriate traffic management strategy is "encourage." However, the "prohibit" strategy may apply to specific classes of vehicles or users at certain times.

LEVEL 5. Assigned to roads that provide a high degree of user comfort and convenience. These roads are normally double lane, paved facilities. Some may be aggregate surfaced and dust abated. Manual on Uniform Traffic Control Devices is applicable. The appropriate traffic management strategy is "encourage."

Mass Wasting. Dislodging and downslope transport of earth and rock as a relatively large (larger than soil particles) unit under direct gravitational stress. Includes slow displacements such as creep, rock glaciers, and solifluction, and also rapid movements such as landslides, rock slides, rock falls, earthflows, debris flows, and avalanches. Usually fluid agents (water, ice, air) play a subordinate role. See erosion.

Mastication. The use of mechanized equipment to reduce surface, ladder and small tree fuels into smaller particles in order to reduce some aspects of fire behavior such as rate of spread. Mastication is a broad category and can be accomplished through methods otherwise known as chipping.

Microclimate. “The climate of small areas,” generally areas smaller than a site or comprising the patches within a site (Ford-Robertson 1971). The climate of a microsite. In this Region, the influence of dominant plant species is often observable and active at the microclimate level.

Microsite. A subdivision of a site, a patch or subsite, that nonetheless has distinctive vegetation, land, or soils. In this Region, very few sites have no noticeable microsites.

Montane Zone. The lower forest zone, associated with forests of Douglas-fir (Pseudotsuga menziesii) and ponderosa pine (Pinus ponderosa), sometimes also including forests of blue spruce (Picea pungens). To the south and west of the UGB, the Montane Zone can also include white fir (Abies concolor). Usually forms a belt between the Colline Zone and the Subalpine Zone (Löve 1970, also see Rydberg 1915ab-1916). Not every site within the Montane Zone is potentially a forest (some are grasslands, rocklands, shrublands, riparian areas, etc.); neither will every forest be dominated by the trees named above.

Morphology. A description of form and structure.

Motor vehicle. Any vehicle which is self-propelled, other than: (1) A vehicle operated on rails; and (2) Any wheelchair or mobility device, including one that is battery-powered, that is designed solely for use by a mobility-impaired person for locomotion, and that is suitable for use in an indoor pedestrian area.

Motor vehicle use map. A map reflecting designated roads, trails, and areas on an administrative unit or a Ranger District of the National Forest System.

Mychorrhizae. A fungus that colonizes plant roots and assists with nutrient exchange.

Mycorrhiza. "The association of fungi and the roots of plants to their mutual advantage" (Hickey and King 2000).

NAIP Imagery – digital ortho photography created by the National Agriculture Imagery Program (NAIP).

National Forest System road. A forest road other than a road which has been authorized by a legally documented right-of-way held by a State, county, or other local public road authority.

National Forest System trail. A forest trail other than a trail which has been authorized by a legally documented right-of-way held by a State, county, or other local public road authority.

Native Species. "A species that was part of an area's original fauna or flora" (Pritchard and others 1982). The area in question must usually be specified, by country, state, physiographic division, ecoregion, county, or other area. A native species cannot be a weed (in the recommended sense), but may nonetheless be an invader in some places and under some management regimes. Examples of native species in UGB include fringed brome, greenback cutthroat trout, silky lupine, Tracy bluegrass, and elk.

Natural Conditions. Conditions substantially unaltered by humans or human activities. As applied in the context of visibility, natural conditions include naturally occurring phenomena that reduce visibility as measured in terms of light extinction, visual range, contrast, or coloration.

Naturalized Species. A species that is not native, but has become part of the natural flora or fauna of an area, and is now capable of survival in the area without cultivation or other management. Many weeds have become naturalized species, but a naturalized species is not always an invader or a weed. The area in question must usually be specified (see native species

above). Examples in UGB include cheatgrass, rainbow trout, smooth brome, poison-hemlock, Kentucky bluegrass, crested wheatgrass and mountain goat.

Objective Maintenance Level. The maintenance level to be assigned at a future date considering future road management objectives, traffic needs, budget constraints, and environmental concerns. The objective maintenance level may be the same as, or higher or lower than, the operational maintenance level. The transition from operational maintenance level to objective maintenance level may depend on reconstruction or disinvestment.

Operational Maintenance Level. The maintenance level currently assigned to a road considering today's needs, road condition, budget constraints, and environmental concerns. It defines the level to which the road is currently being maintained.

Perennial. "Living for a number of years" (Hickey and King 2000).

Perennial stream. A stream that flows continuously.

Phylogeny. "The relationships between plants as determined by their evolutionary history" (Hickey and King 2000).

Pounds per Square Inch (PSI): The number of pounds of ground pressure exerted over one square inch of soil; a metric to assess soil compaction and to define equipment limits.

Propagule. "Any structure capable of giving rise to a new plant by sexual or asexual means" (Hickey and King 2000).

PSD Increments. The maximum increases in ambient pollution concentrations allowed over baseline concentrations. See 40 CFR 51.166 (c) for increments for specific pollutants.

Quadratic Mean Diameter (QMD): The square root of the arithmetic average of the squared values across a particular inventory (Avery and Burkhart 2002).

Realignment. Activity that results in a new location of an existing road or portions of an existing road and treatment of the old roadway.

Reconstruction (road or trail). Improvement and/or realignment of a travelway.

Regional Haze Visibility Impairment. Any humanly perceptible change in visibility (light extinction, visual range, contrast, coloration) from that which would have existed under natural conditions, caused predominantly by a combination of many sources from, and occurring over, a wide geographic area.

Relict. "A plant that has survived from a previous age or, because of changed circumstances, is growing in a place geographically remote from its most closely related species" (Hickey and King 2000).

Rhizome. A horizontal, "creeping, usually thickened, stem or branch growing partly or entirely under the surface of the ground" (Dayton 1950), by which the plant vegetatively reproduces.

Riparian Complex. A kind of mapped ecological unit which supports or may potentially support a specified pattern of community types, soils, landforms, and hydrological characteristics. It is identified on the basis of its potential vegetation (the highest seral stage attained in any of its regularly-appearing patches), overall geomorphology, geological substrate, and the repeated patterns of patches within the map unit. Boundaries and definition of patches within the riparian complex are determined by plant communities and community types, stream channel types and aquatic habitat types, and fluvial landforms. The pattern of patches is relatively constant among sites in the same riparian ecological unit that are relatively unaffected by management, but the pattern often changes as management intensifies (after Padgett and others 1987).

Riparian Ecosystem. A distinct, terrestrial ecosystem, often located spatially between an aquatic ecosystem and a drier ecosystem, characterized by distinctive riparian vegetation and soils requiring high water tables at some time in the growing season, and often occupying distinctive landforms (floodplains, alluvial benches) as well. A riparian ecosystem can be distinguished from an aquatic ecosystem that sometimes might be adjacent to it, because the substrate for the riparian ecosystem is true soil.

Riparian Vegetation. "Vegetation growing on or near the banks of a stream or other body of water on soils that exhibit some wetness characteristics during some portion of the growing season" (Helm and others 1985). It is generally not possible to distinguish riparian plant communities from non-riparian ones on the basis of present vegetation. But it is possible to distinguish riparian plant associations (potential plant communities) from non-riparian ones. Distinguishing and delineating riparian plant communities is much more successful than delineating riparian areas on the basis of individual plant species (see hydrophyte). "The [climax plant] community is a more reliable indicator than any single species of it" (Clements 1920:30).

Road. A motor vehicle route over 50 inches wide, unless identified and managed as a trail.

Road improvement. Activity that results in an increase of an existing road's traffic service level, expands its capacity, or changes its original design function.

Sensitive Receptor. The AQRV, or part thereof, that is the most responsive to, or the most easily affected by the type of air pollution in question.

Sensitive Receptor Indicator. A measureable physical, chemical, biological, or social (e.g. odor) characteristic of a sensitive receptor.

Shade-tolerance – Species that have a tolerance to shading by other species. Shade tolerant species will grow and regenerate under a stand's over-story.

Shrub. "A perennial, woody plant that differs from a tree by its low growth [generally < 6 m] and the possession of several stems arising from the base" (Penfound 1967).

Shrubland. "Any land on which shrubs dominate the vegetation" (Penfound 1967).

Silviculture. The practice of controlling the planting, growth, composition, health, and quality of forests to meet diverse needs and values.

Smoke Sensitive Area. Any occupied areas where smoke fumigation occurs or may occur. Young children, the elderly and individuals with decreased lung function are most sensitive to smoke in smoke sensitive areas.

Spruce mix. Areas where spruce is dominant, but species other than spruce and aspen may be present.

Stand density index (SDI): See Appendix B, this document for explanation; a metric for measuring forested stand density. For this document, averages are reported within the treatment units, where stand examination inventories have been conducted. This is an FVS modeled average for this document.

Stationary Source. A source of pollution that is well defined, such as the smokestack of a coal-fired power plant or smelter.

Stocking – an indication of growing space occupancy relative to a pre-established standard, such as basal area or trees per acre.

Storage. Used to describe an intermittent use road during the time it is closed to vehicular use. When referring to a National Forest System road, storage is synonymous with a Maintenance Level 1.

Subalpine Zone. A forest zone, associated with closed forests, closely associated with forests of subalpine fir (Abies bifolia and its close relative A. Arizonica) and Engelmann spruce (Picea engelmannii). Not every site within the Subalpine Zone is potentially a forest (some are grasslands, rocklands, shrublands, riparian areas, etc.); neither will every forest be dominated by the trees named above (see Rydberg 1915ab).

Succession. "The progressive development of vegetation towards its highest ecological expression, the climax; replacement of one plant community by another" (Pritchard and others 1982). The whole sequence of plant communities is called a sere. Secondary succession is usually more important to management than primary succession (see definitions of those terms).

Symbiosis. "The arrangement whereby two different organisms (symbionts) co-exist, not necessarily to their mutual advantage" (Hickey and King 2000).

Taxonomy. "The science of classification. In botany,…The classification or arrangement of plants according to their natural relationships and the principles underlying such classification" (Dayton 1950).

Temporary road. A road necessary for emergency operations or authorized by contract, permit, lease, or other written authorization that is not a forest road or a forest trail and that is not included in a forest transportation atlas.

Trail. A route 50 inches or less in width or a route over 50 inches wide that is identified and managed as a trail.

Transpiration. The passage of water vapor from a plant through a membrane or pores.

Trees per acre (TPA): The number of trees, on average, on an acre of land where stand examination inventories have been conducted; this is a modeled average for this document.

Trophic. "Relating to the processes of energy and nutrient transfer from one or more organisms to others in an ecosystem" (Pritchard and others 1982).

Unauthorized Road or Trail. A road or trail that is not a forest road or trail or a temporary road or trail and that is not included in a forest transportation atlas.

Uneven-aged: Forest stand composed of intermingling of trees that differ markedly in age (Avery and Burkhart 2002)

Upper Diameter Limit (UDL) – the diameter at which removal of trees is restricted or meets the objectives of the silvicultural prescription. This may be a hard value or a flexible estimate depending on the type of thinning and the objectives of the silvicultural prescription.

Utes. A collection of Native North American tribes and bands speaking mutually intelligible languages in the Uto-Aztecan family, who mainly live in Colorado, Utah, and New Mexico.

Visibility Impairment. Any humanly perceptible change in visibility (visual range, contrast, coloration) from that which would have existed under natural conditions. (40 CFR 51.301(x)).

Visual Range. The distance at which a large black object would just disappear from view.

Volatile Organic Compound (VOC). Any compound of carbon, except those excluded by EPA that participates in atmospheric photochemical reactions (See 40 CFR 51.100(s)).

Volatilization. Evaporation of a substance.

Weighted average: for this document, the forest metric of interest (QMD, TPA, SDI, etc.) multiplied by the sum FVS output times the number of acres divided by the total acres affected.

Wetland. Land area that is saturated with water, either permanently or seasonally.

Wickiups. Wickiups are temporary brush structures of Ute Indian manufacture and use while preforming hunting and gathering tasks as part of their seasonal rounds.

Wildland Urban Interface (WUI). The area generally within one mile of any communities, administrative sites, utility corridors, developed sites, and ski areas.

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APPENDIX A – SILVICULTURAL PRESCRIPTION MATRIX

Spruce Beetle Epidemic and Aspen Decline Management Response

Treatment objectives within the matrix are a combination of objectives for silvicultural, fuels, and wildlife programs to accomplish the identified SBEADMR purpose and need *(See Chapter 1).* During surveys for individual treatments, additional opportunities/objectives may be determined to enhance resources with the identified silvicultural treatment (example: opportunity to decrease existing soil compaction via decommission/rehabilitation of previously existing skid trails). During implementation, design features will be applied to minimize, avoid, or mitigate impacts to existing resources. See *Appendix B* for full list of design features.

Effects indicators common to each prescription are: vertical structure, horizontal cover, age-class, and species composition. These indicators will be monitored to determine effectiveness of the treatments to meet identified objectives. See *Appendix C.*

Due to the need to track lynx habitat in accordance with the Southern Rockies Lynx Amendment, pertinent lynx information for each prescription is included as well.

Spruce-fir Structural Stand Conditions	**Resiliency Rx**		**Recovery and Resiliency Rx**		**Recovery Rx**	
	<40% overstory mortality[1]		**>40% <90% overstory mortality[1]** **(exceeds windthrow threshold [3])**		**>90% overstory mortality[1]** **(exceeds windthrow threshold [3])**	
	Stand multi-storied[2] and averages ≥35% DHC[4] and advanced regeneration are above mean snow depth.	**Stand is multi-storied and <35% DHC[4].**	**Stand multi-storied[2] and averages ≥35% DHC[4] and advanced regeneration are above mean snow depth.**	**Stand is multi-storied[2] and <35% DHC[4].**	**Stand multi-storied[2] and averages ≥35% DHC[4] and advanced regeneration are above mean snow depth.**	**Stand is multi-storied[2] and <35% DHC[4].**
Single-storied 	**Objectives of treatment:** • Generate and maintain multiple stories. • Maintain shade-tolerant species. • WUI: Decrease potential surface fire intensity via reduced surface fuels. • WUI: Reduce potential for crown fire by reducing canopy continuity. **Silvicultural Rx:** Initiate UAM[4] using ITS[4] or group selection (<3 tree length – 0.25 to 2 acre openings). Removal centered on pockets of dead and dying. Harvest approximately 15 to 25% of the stand area with small openings tree lengths). Emphasis for group placement is in pockets of dead or dying trees. Individual tree selection will be conducted as needed to remove beetle affected trees in the matrix (areas between group selection openings). If needed, mechanical site preparation will be used to promote seed germination and seedling survival. Maintain "wind firmness" by removing no more than 40% of the present stocking within the matrix. Trees with active beetle life forms in the tree will be considered for removal. Live trees, older dead trees and recently killed trees will be retained to maintain 60% of the original stocking. These stands generally lack understory vegetation (trees), but it may be present in isolated pockets within stands Minimize or avoid to the extent practicable impacts to advanced regeneration during layout and operations. Focus on protecting high quality advanced regeneration (>35% DHC) in blocks of 0.3 acres or larger where it occurs. **Lynx Habitat:** suitable. **SRLA[5]:** Stand is not multi-storied and therefore not subject to cap restrictions.		**Objectives of treatment:** • Generate and maintain multiple stories. • Shift species composition toward drought-resistant, shade-intolerant species. • WUI: Decrease potential surface fire intensity via reduced surface fuels. • WUI: Reduce potential for crown fire by reducing canopy continuity. **Silvicultural Rx:** Remove all dead-dying Spruce-fir and plant where adequate seed sources are lacking – Combination of Group Select where mortality is patchy to larger CC[4] where mortality is extensive. If needed, mechanical site preparation will be used to promote seed germination and seedling survival. If portions of the stand are less than 40% stocked, create small openings (0.25 to 2 acres or <3 tree lengths) otherwise removal of the entire stand may be needed. In areas where the entire stand will not be removed, maintain "wind firmness" by removing no more than 40% of the present stocking within the matrix. These stands generally lack understory vegetation (trees), but it may be present in isolated pockets within stands Minimize or avoid to the extent practicable impacts to advanced regeneration during layout and operations. Focus on protecting high quality advanced regeneration (>35% DHC) in blocks of 0.3 acres or larger where it occurs. **Lynx Habitat:** suitable. **SRLA[5]:** Stand is not multi-storied and therefore not subject to cap restrictions.		**Objectives:** • Generate and maintain multiple stories. • Shift species composition toward drought-resistant, shade-intolerant species. • WUI: Decrease potential surface fire intensity via reduced surface fuels. **Silvicultural Rx:** Remove all dead-dying spruce-fir and plant where adequate natural seed sources are lacking. Larger CC[4] will be used where mortality is extensive. If needed, mechanical site preparation will be used to promote seed germination and seedling survival. If portions of the stand is less than 40% stocked, create small openings (<0.25 to 2 acres or <3 tree lengths) otherwise removal of the entire stand may be needed. In areas where the entire stand will not be removed, maintain "wind firmness" by removing no more than 40% of the present stocking within the matrix. These stands generally lack understory vegetation (trees), but it may be present in isolated pockets within stands Minimize or avoid to the extent practicable impacts to advanced regeneration during layout and operations. Focus on protecting high quality advanced regeneration (>35% DHC) in blocks of 0.3 acres or larger. **Lynx Habitat:** If 90% or greater of the overstory is dead or projected to be dead in two years due to high levels of beetle infestation, may be considered unsuitable lynx habitat if it lacks a live green understory (Southern Rockies Lynx Amendment Implementation Guide Page 16). The goal is to protect high quality, >35% advanced regeneration to the maximum extent practicable. **SRLA[5]:** Stand is not multi-storied and therefore not subject to cap restrictions.	

Spruce-fir Structural Stand Conditions	Resiliency Rx		Recovery and Resiliency Rx		Recovery Rx	
	<40% overstory mortality[1]		>40% <90% overstory mortality[1] (exceeds windthrow threshold [3])		>90% overstory mortality[1] (exceeds windthrow threshold [3])	
	Stand multi-storied[2] and averages ≥35% DHC[4] and advanced regeneration are above mean snow depth.	**Stand is multi-storied and <35% DHC[4].**	**Stand multi-storied[2] and averages ≥35% DHC[4] and advanced regeneration are above mean snow depth.**	**Stand is multi-storied[2] and <35% DHC[4].**	**Stand multi-storied[2] and averages ≥35% DHC[4] and advanced regeneration are above mean snow depth.**	**Stand is multi-storied[2] and <35% DHC[4].**
Two-storied *(considered multi-storied under SRLA)* **(Continued) Two-storied** *(considered multi-storied under SRLA)* 	**Objectives:** • Generate and maintain multiple stories. • Maintain shade-tolerant species. • WUI: Decrease potential surface fire intensity via reduced surface fuels. • WUI: Reduce potential for crown fire by reducing canopy continuity. • Within 200' of infrastructure in WUI reduce potential for crown fire and ember sources by reducing ladder fuels. **Silvicultural Rx:** Initiate UAM[4] using ITS[4] or group selection 0.25 to 2 acre openings (<3 tree lengths). Removal of Dead and dying. Removal centered on pockets of dead and dying. Minimize or avoid to the extent practicable impacts to advanced regeneration during layout and operations. Focus on protecting high quality advanced regeneration (>35% DHC) in blocks of 0.3 acres or larger. **Lynx Habitat:** suitable – high quality. **SRLA:** [5] Track under Veg S1, S2, and S6[5]. Uneven-aged management prescription must be used and tracked under VEG S1 and S2. Incidental damage to advance regeneration is measured at 20% of the treated stand. Roads within treated units- included in incidental damage estimates from logging. Roads outside treatment units – 100% of the footprint of the road will be converted to stand initiation structural stage (SISS) – lynx habitat in an unsuitable condition. WUI treatments will be tracked under VEG S5 since they are intended to reduce seedling/sapling density.	**Objectives:** • Generate and maintain multiple stories. • Maintain shade-tolerant species. • WUI: Decrease potential surface fire intensity via reduced surface fuels. • WUI: Reduce potential for crown fire by reducing canopy continuity. • Within 200' of infrastructure in WUI reduce potential for crown fire and ember sources by reducing ladder fuels. **Silvicultural Rx:** Initiate UAM[4] using ITS[4] or group selection 0.25 to 2 acre openings (< 3 tree lengths). Removal of Dead and dying. Minimize or avoid to the maximum extent practicable impacts to live advanced regeneration during layout and operations. Focus on protecting high quality advanced regeneration (>35% DHC) in blocks of 0.3 acres or larger. **Lynx Habitat:** suitable. Incidental damage must be addressed in the Biological Assessment but is not tracked under VEG S6. [5] **SRLA:** Track under Veg S1 and S2. Uneven-aged management prescription must be used and tracked under VEG S1 and S2. Incidental damage to advance regeneration is measured at 25% of the treated stand. Roads within treated units- included in incidental damage estimates from logging. Roads outside treatment units – 100% of the footprint of the road will be converted to stand initiation structural stage (SISS) – lynx habitat in an unsuitable condition. WUI treatments will be tracked under VEG S5 since they are intended to reduce seedling/sapling density	**Objectives:** • Generate and maintain multiple stories. • Maintain shade-tolerant species. • WUI: Decrease potential surface fire intensity via reduced surface fuels. • WUI: Reduce potential for crown fire by reducing canopy continuity. • Within 200' of infrastructure in WUI reduce potential for crown fire and ember sources by reducing ladder fuels **Silvicultural Rx:** Overstory removal (salvage) of dead and dying. Where mortality is lower, use un-even-aged management prescriptions- patch cuts 0.25 to 2 acres openings (< 3 tree lengths) or individual tree selection centered on pockets of dead and dying. Removal may be more extensive where mortality is high. Live trees that pose a blow down risk may also be removed. Maintain "wind firmness" by not removing more than 40% of the present stocking within a residual stand. Minimize or avoid to the maximum extent practicable impacts to live advanced regeneration during layout and operations. Focus on protecting high quality advanced regeneration (>35% DHC) in blocks of 0.3 acres or larger. **Lynx Habitat:** suitable – high quality. **SRLA: If** uneven-aged management prescription is used – track under VEG S1 and S2[5]. Incidental damage to advanced regeneration is measured at 35% of treated stand. Salvage or uneven-aged management prescription – track under VEG S1, S2 and S6. Incidental damage to advanced regeneration is measured at 35% of treated stand. Roads within treatment units are included in incidental damage from logging. Roads outside treatment unit – 100% of the foot-print of the road will be converted to stand initiation structural stage (SISS) – lynx habitat in an unsuitable condition. Acres tracked under VEG S1, S2 and S6[5]. WUI treatments will be tracked under VEG S5 since	**Objectives:** • Generate and maintain multiple stories. • Shift species composition toward drought-resistant, shade-intolerant species. • WUI: Decrease potential surface fire intensity via reduced surface fuels. • WUI: Reduce potential for crown fire by reducing canopy continuity. • Within 200' of infrastructure in WUI reduce potential for crown fire and ember sources by reducing ladder fuels **Silvicultural Rx**: Overstory removal (salvage) of dead and dying. Where mortality is lower, use uneven-aged management prescriptions- patch cuts 0.25 to 2 acres openings (< 3 tree lengths) or individual tree selection centered on pockets of dead and dying. Removal may be more extensive where mortality is high. Live trees that pose a blow down risk may also be removed. Maintain "wind firmness" by not removing more than 40% of the present stocking within a residual stand. Minimize or avoid to the maximum extent practicable impacts to live advanced regeneration during layout and operations. Focus on protecting high quality advanced regeneration (>35% DHC) in blocks of 0.3 acres or larger. **Lynx Habitat:** suitable - incidental damage must be addressed in the Biological Assessment but is not tracked under VEG S6. **SRLA:** Uneven-aged management prescription – track under VEG S1 and S2[5]. Incidental damage to advanced regeneration is measured at 35% of treated stand. Salvage or even-aged management prescription – track under VEG S1and S2. When an uneven-aged Rx is used, incidental damage to advanced regeneration is measured at 35% of treated stand. Roads within treatment units are included in incidental damage from logging. Roads outside treatment unit – 100% of the foot-print of the road will be converted to stand initiation structural stage (SISS) – lynx habitat in an unsuitable condition. WUI treatments will be tracked under VEG S5 since they are intended to	**Objectives:** • Generate and maintain multiple stories. • Maintain shade-tolerant species. • WUI: Decrease potential surface fire intensity via reduced surface fuels. **Silvicultural Rx:** Stand no longer considered two-story due to dead overstory. Overstory removal (salvage) of dead and dying. Minimize or avoid to the maximum extent practicable impacts to live advanced regeneration during layout and operations. Focus on protecting high quality advanced regeneration (>35% DHC) in blocks of 0.3 acres or larger. **Lynx Habitat:** Depends upon understory characteristics – if it provides suitable habitat for hares then it is considered suitable. **SRLA:** Incidental damage to advanced regeneration is tracked under VEG S1 and S2. VEG S6[5] does not apply when >90% of overstory is dead or dying. Where a live understory over average snow depth is present, incidental damage to habitat is estimated to be 50% of treated acres and 100% of new roads if they do not transverse a treatment unit.	**Objectives:** • Generate and maintain multiple stories. • Shift species composition toward drought-resistant, shade-intolerant species. • WUI: Decrease potential surface fire intensity via reduced surface fuels. **Silvicultural Rx:** Stand no longer considered two-story due to dead overstory. Overstory removal (salvage) of dead and dying. Minimize or avoid to the maximum extent practicable impacts to live advanced regeneration during layout and operations. Focus on protecting high quality advanced regeneration (>35% DHC) in blocks of 0.3 acres or larger. **Lynx Habitat:** Depends upon understory characteristics – if it provides suitable habitat for hares then it is considered suitable. **SRLA:** Incidental damage to advanced regeneration is tracked under VEG S1 and S2. VEG S6[5] does not apply when >90% of overstory is dead or dying. Where a live understory over average snow depth is present, incidental damage to habitat is estimated to be 50% of treated acres and 100% of new roads if they do not transverse a treatment unit.

DRAFT

Spruce-fir Structural Stand Conditions	Resiliency Rx		Recovery and Resiliency Rx		Recovery Rx	
	<40% overstory mortality[1]		>40% <90% overstory mortality[1] (exceeds windthrow threshold [3])		>90% overstory mortality[1] (exceeds windthrow threshold [3])	
	Stand multi-storied[2] and averages ≥35% DHC[4] and advanced regeneration are above mean snow depth.	**Stand is multi-storied and <35% DHC[4].**	**Stand multi-storied[2] and averages ≥35% DHC[4] and advanced regeneration are above mean snow depth.**	**Stand is multi-storied[2] and <35% DHC[4].**	**Stand multi-storied[2] and averages ≥35% DHC[4] and advanced regeneration are above mean snow depth.**	**Stand is multi-storied[2] and <35% DHC[4].**
			they are intended to reduce seedling/sapling density	reduce seedling/sapling density		
Multiple canopy layers – three or more	**Objectives:** • Generate and maintain multiple stories. • Maintain shade-tolerant species. • WUI: Decrease potential surface fire intensity via reduced surface fuels. • WUI: Reduce potential for crown fire by reducing canopy continuity. • Within 200' of infrastructure in WUI reduce potential for crown fire and ember sources by reducing ladder fuels. **Silvicultural Rx:** Initiate UAM[4] using ITS or group selection patch cuts 0.25 to 2 acre openings (<3 tree lengths). Removal centered on pockets of dead and dying. Minimize or avoid to the extent practicable impacts to advanced regeneration during layout and operations. Focus on protecting high quality advanced regeneration (>35% DHC) in blocks of 0.3 acres or larger. **Lynx Habitat:** Suitable – high quality **SRLA:** Track under Veg S1, S2 and S6[5]. Uneven-aged management prescription must be used and tracked under VEG S1 and S2. Incidental damage to advance regeneration is measured at 20% of the treated stand. Roads within treated units- included in incidental damage estimates from logging. Roads outside treatment units – 100% of the footprint of the road will be converted to stand initiation structural stage (SISS) – lynx habitat in an unsuitable condition. WUI treatments will be tracked under VEG S5 since they are intended to reduce seedling/sapling	**Objectives:** • Generate and maintain multiple stories. • Maintain shade-tolerant species. • WUI: Decrease potential surface fire intensity via reduced surface fuels. • WUI: Reduce potential for crown fire by reducing canopy continuity. Within 200' of infrastructure in WUI reduce potential for crown fire and ember sources by reducing ladder fuels. **Silvicultural Rx:** Initiate UAM using ITS[4] or group selection patch cuts 0.25 to 2 acre openings (< 3 tree lengths). Removal centered on pockets of dead and dying. Minimize or avoid to the extent practicable impacts to advanced regeneration during layout and operations. Focus on protecting high quality advanced regeneration (>35% DHC) in blocks of 0.3 acres or larger. **Lynx Habitat:** Suitable– incidental damage must be addressed in the Biological Assessment but is not tracked under VEG S6[5]. **SRLA:** Track under Veg S1 and S2. Uneven-aged management prescription must be used and tracked under VEG S1 and S2. Incidental damage to advance regeneration is measured at 25% of the treated stand. Roads within treated units- included in incidental damage estimates from logging. Roads outside treatment units – 100% of the footprint of the road will be converted to stand initiation structural stage (SISS) – lynx habitat in an unsuitable condition. Road acres tracked under VEG S1, S2. WUI treatments will be tracked under VEG S5 since they are intended to reduce seedling/sapling density	**Objectives:** • Generate and maintain multiple stories. • Maintain shade-tolerant species. • WUI: Decrease potential surface fire intensity via reduced surface fuels. • WUI: Reduce potential for crown fire by reducing canopy continuity. Within 200' of infrastructure in WUI reduce potential for crown fire and ember sources by reducing ladder fuels. **Silvicultural Rx:** If two canopies remain alive the stand is still considered multi-storied. Overstory removal (salvage) of dead and dying. Where mortality is lower, use un-even-aged management prescriptions – patch 0.25 to 2 acre openings (<3 tree lengths) or individual tree selection centered on pockets of dead and dying. Removal may be more extensive where mortality is high. Live trees that pose a blow down risk may also be removed. Maintain "wind firmness" by not removing more than 40% of the present stocking within a residual stand. Minimize or avoid to the maximum extent practicable impacts to live advanced regeneration during layout and operations. Focus on protecting high quality advanced regeneration (>35% DHC) in blocks of 0.3 acres or larger. **Lynx Habitat:** Suitable – high quality. **SRLA:** Uneven-aged management prescription – track under VEG S1 and S2[5]. Incidental damage to advanced regeneration is measured at 20% of treated stand. Salvage or even-aged management prescription – track under VEG S1, S2 and S6. Incidental damage to advanced regeneration is measured at 30% of treated stand. Roads within treatment units are included in incidental damage from logging. Roads outside treatment unit – 100% of the	**Objectives:** • Generate and maintain multiple stories. • Shift species composition toward drought-resistant, shade-intolerant species. • WUI: Decrease potential surface fire intensity via reduced surface fuels. • WUI: Reduce potential for crown fire by reducing canopy continuity. Within 200' of infrastructure in WUI reduce potential for crown fire and ember sources by reducing ladder fuels. **Silvicultural Rx**: If two canopy remains alive the stand is still considered multi-storied. Overstory removal (salvage) of dead and dying. Where mortality is lower, use un-even-aged management prescriptions- patch cuts 0.25 to 2 acre openings (<3 tree lengths) or individual tree selection centered on pockets of dead and dying. Removal may be more extensive where mortality is high. Live trees that pose a blow down risk may also be removed. Maintain "wind firmness" by not removing more than 40% of the present stocking within a residual stand. Minimize or avoid t the maximum extent practicable impacts to live advanced regeneration during layout and operations. Focus on protecting high quality advanced regeneration (>35% DHC) in blocks of 0.3 acres or larger. **Lynx Habitat:** Suitable - incidental damage must be addressed in the Biological Assessment but is not tracked under VEG S6[5]. **SRLA:** Uneven-aged management prescription – track under VEG S1 and S2. Incidental damage to advanced regeneration is measured at 20% of treated stand. Salvage or even-aged management prescription – track under VEG S1and S2[5]. When even-aged Rx is used, incidental damage to advanced regeneration is measured at 30% of treated stand. Roads within treatment units are	**Objectives:** • Generate and maintain multiple stories. • Maintain shade-tolerant species. • WUI: Decrease potential surface fire intensity via reduced surface fuels. • Within 200' of infrastructure in WUI reduce potential for crown fire and ember sources by reducing ladder fuels. **Silvicultural Rx:** If two canopy remains alive the stand is still considered multi-storied. Overstory removal (salvage) of dead and dying. Minimize or avoid to the maximum extent practicable impacts to live advanced regeneration during layout and operations. Focus on protecting high quality advanced regeneration (>35% DHC) in blocks of 0.3 acres or larger. **Lynx Habitat:** depends upon understory characteristics – if it provides suitable habitat for hares then it is considered suitable. **SRLA:** Incidental damage to advanced regeneration is tracked under VEG S1 and S2. VEG S6[5] does not apply when >90% of overstory is dead or dying. Where a live understory over average snow depth is present, incidental damage to habitat is estimated to be 50% of treated acres and 100% of new roads if they do not transverse a treatment unit. WUI treatments will be tracked under VEG S5 since they are intended to reduce seedling/sapling density **Note**: If the stand has at two or more living layers the Veg S6 standard still applies. This will be determined at the project-level.	**Objectives:** • Generate and maintain multiple stories. • Shift species composition toward drought-resistant, shade-intolerant species. • WUI: Decrease potential surface fire intensity via reduced surface fuels. • Within 200' of infrastructure in WUI reduce potential for crown fire and ember sources by reducing ladder fuels. **Silvicultural Rx:** If two canopy remains alive the stand is still considered multi-storied. Overstory removal (salvage) of dead and dying. Minimize or avoid to the maximum extent practicable impacts to live advanced regeneration during layout and operations. Focus on protecting high quality advanced regeneration (>35% DHC) in blocks of 0.3 acres or larger. **Lynx Habitat:** depends upon understory characteristics – if it provides suitable habitat for hares then it is considered suitable. **SRLA:** Incidental damage to advanced regeneration is tracked under VEG S1 and S2[5]. VEG S6[5] does not apply when >90% of overstory is dead or dying. Where a live understory over average snow depth is present, incidental damage to habitat is estimated to be 50% of treated acres and 100% of new roads if they do not transverse a treatment unit. WUI treatments will be tracked under VEG S5 since they are intended to reduce seedling/sapling density **Note:** If the stand has at two or more living layers the Veg S6 standard still applies. This will be determined at the project-level.

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Spruce-fir Structural Stand Conditions	Resiliency Rx		Recovery and Resiliency Rx		Recovery Rx	
	<40% overstory mortality[1]		>40% <90% overstory mortality[1] (exceeds windthrow threshold [3])		>90% overstory mortality[1] (exceeds windthrow threshold [3])	
	Stand multi-storied[2] and averages ≥35% DHC[4] and advanced regeneration are above mean snow depth.	**Stand is multi-storied and <35% DHC[4].**	**Stand multi-storied[2] and averages ≥35% DHC[4] and advanced regeneration are above mean snow depth.**	**Stand is multi-storied[2] and <35% DHC[4].**	**Stand multi-storied[2] and averages ≥35% DHC[4] and advanced regeneration are above mean snow depth.**	**Stand is multi-storied[2] and <35% DHC[4].**
	density		foot-print of the road will be converted to stand initiation structural stage (SISS) – lynx habitat in an unsuitable condition. Road acres tracked under VEG S1, S2. WUI treatments will be tracked under VEG S5 since they are intended to reduce seedling/sapling density	included in incidental damage from logging. Roads outside treatment unit – 100% of the foot-print of the road will be converted to stand initiation structural stage (SISS) – lynx habitat in an unsuitable condition. Acres tracked under VEG S1 and S2[5]. WUI treatments will be tracked under VEG S5 since they are intended to reduce seedling/sapling density		

[1] Percent overstory mortality – amount of overstory trees (all species) that are dead or dying. Trees that are infected by beetles (bark colored boring dust in bark crevices and around base of standing trees) and are expected to die within 2 years will be considered dead or dying.

[2] Multi-storied spruce-fir – the SRLA amendment defines as at least two layers of live vegetation layers combined with an overstory that provides at least 40% live canopy (mature overstory) closure.

[3] Removal and/or mortality of approximately ≥40% live stand overstory increases likelihood for windthrow in remaining stand overstory.

[4] Definitions: DHC = dense horizontal cover, D&D = dead & dying, ITS = individual tree selection, UAM = uneven-aged management, CC = clear-cut.

[5] SRLA = Southern Rockies Lynx Amendment, VEG S1 = standard that applies to vegetation management treatments that regenerate forested lands (Attachment 1-2 of the SRLA Record of Decision), VEG S2 = standard that applies to timber management projects that regenerate forests except for fuel treatment projects in WUI (Attachment 1-3 SRLA Record of Decision) , VEG S6 = standard that applies to all vegetation management projects within multi-story mature to late successional conifer forests (Attachment 1-4 of the SRLA Record of Decision).

Uneven-aged Vegetation Management
Uneven-aged management is recognized as a proactive approach to mimic natural gap dynamics that maintain or encourage multi-story attributes while accomplishing other resource management objectives. Gaps are created naturally in the canopy of stands from small bug infestations, diseases, blowdown pockets of trees, and other natural influences.

The general principle of uneven-aged vegetation management, as identified in Exception 4 in VEG S6, is the small group selections that consist of small forest openings (approximately 1-2 acres in size) in which the openings created by group selection will not exceed 20 percent of a stand in a single entry, but individual tree selection can occur throughout an entire stand or between the groups. Therefore, uneven-aged treatments will approximate natural succession and disturbance processes while maintaining and providing habitat conditions that support lynx and snowshoe hare through time in both the stand initiation structural stage and in mature, multi-story conifer vegetation (VEG O1 and O2). Additionally, uneven-aged treatments will be focused in areas that have the potential to improve winter snowshoe hare habitat but presently have poorly-developed understories that lack dense horizontal cover (VEG O4).

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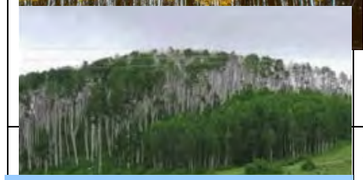
Aspen Structural Stand Conditions	Objectives	Suckering Potential High	Suckering Potential Low	SRLA Vegetation Management Direction	Detailed Prescription
Aspen without SAD or <50% SAD *(Aspen without SAD lesser priority for regeneration objectives)* 	➢ Stimulate robust sprouting of aspen and create a younger, stand more resilient to SAD. The goal is to mimic natural disturbance patterns resulting from a stand replacing event. ➢ WUI: Decrease potential surface fire intensity via reduced surface fuels	➢ Coppice harvest cut if tree defect is low to high. ➢ Can be prescribe burned if harvest cut site access is limited, however these sites are unlikely to support broadcast burns unless there is a moderate fine fuel component.	No Treatment	If mapped as secondary habitat (within 300m of primary spruce-fir habitat) impacts must be addressed in the BA. SRLA does not limit regeneration harvest prescriptions in aspen.	Remove all live aspen trees from the stand to trigger sprouting (coppice) to re-establish pure stand of aspen growing in open conditions. Make units large or have multiple smaller units in the same general area to minimize effect of browsing from wild ungulates and domestic livestock. If additional protection from browsing is needed, consider fencing or leaving slash in place that is not near infrastructure. Pile or broadcast burning to reduce residual slash Broadcast burning in these types of stands to remove some overstory trees and stimulate regeneration, though not feasible in every situation, is still a viable treatment in stands where fine fuel such as grass, leaf litter, and brush, are present, particularly in the fall when vegetation is curing. These stands are not a priority for broadcast burning but stand-specific opportunities do exist and should be utilized.
	In stands near WUI there is long -term value in trying to maintain some aspen on the landscape to reduce fire risk to the adjacent WUI. Site specific opportunities may be present to regenerate enough aspen through removal of the aspen overstory and mastication of the brush understory to accomplish this objective.	Research has indicated that treatments in aspen with >50% overstory mortality are generally not effective at promoting regeneration so treatment-specific prescription would be based on additional information indicating a likelihood of treatment success.	➢ Defer & allow stand to follow natural successional pathway of sparse aspen/shrub field. ➢ Intensive management by planting a site-adapted conifer species may be an option.	If mapped as secondary habitat (within 300m of primary spruce-fir habitat) impacts must be addressed in the BA. SRLA does not limit regeneration harvest prescriptions in aspen.	Research has indicated that treatments in aspen with >50% overstory mortality are generally not effective at promoting regeneration so treatment-specific prescription would be based on additional information indicating a likelihood of treatment success.
Aspen overstory and Spruce-fir understory 	**< 50% SAD** - Stimulate robust sprouting of aspen and create an even-aged stand structure. The goal is to mimic natural disturbance patterns resulting from a stand replacing event. **>50% SAD** – Defer treatment allowing spruce-fir and other conifers to establish dominance within the stand. In stands near WUI there is long -term value in trying to maintain some aspen on the landscape to reduce fire risk to the adjacent WUI. Site specific opportunities may be present to regenerate enough aspen through removal of both the aspen overstory and the spruce/fire understory to accomplish this objective.	**Mature aspen stand** ➢ Coppice harvest cut if defect low to high ➢ Use broadcast burning to stimulate additional aspen when appropriate ➢ Remove fir and aspen components to stimulate additional aspen ➢ WUI: Decrease potential surface fire intensity via reduced surface fuels **Young healthy aspen stand** ➢ Selective removal of fir component ➢ WUI: As necessary pile/burn the removed spruce/fir components to maintain low potential surface fire intensity	➢ Defer aspen cut and allow stand to succeed to a Spruce-fir dominated stand.	If mapped as secondary habitat (within 300m of primary spruce-fir habitat) impacts must be addressed in the BA. SRLA does not limit regeneration harvest prescription in aspen. If the spruce-fir component in the stand creates a multi-storied condition then the level of harvest must be tracked under Veg S5.	**Mature aspen stand w/<50% SAD** - Remove all live aspen trees from the stand to trigger sprouting (coppice) and re-establish pure stand of aspen growing in open conditions. Make units large enough in size (30-50 acres) or have multiple smaller units in the same general area to minimize effect of browsing from wild ungulates and domestic livestock. If additional protection from browsing is needed, consider fencing or leaving slash in place that is not near infrastructure. **Young healthy aspen stand w/<50% SAD** – Selective removal of spruce-fir to set back successional processes in the stand. Goal is to enhance aspen in treated stands. In areas where spruce-fir component is abundant and multi-storied, consider letting it succeed to a conifer-dominated stand to benefit Canada lynx. **Prescribed fire** – Utilize as needed to encourage aspen regeneration. These types of stands are included in the opportunity area but will be a low priority for broadcast burning.

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					Broadcast burning these types of stands will be more difficult to accomplish than burning stands with aspen and dry mixed conifer or stands of ponderosa pine with aspen. Fires occurring in stands with spruce-fir can be stand-replacing and/or difficult to manage/control.
Mixed conifer with aspen	**Objectives**	**Suckering Potential High**	**Suckering Potential Low**	**SRLA Vegetation Management Direction**	**Detailed Prescription**
 Mixed conifer with aspen component. Plurality of species cover is Englemann spruce wirh aspen. Other conifer species includiing sub-apline fir, Douglas-fir, blue speruce, white fir, lodgepole pine and Ponderosa pine may aslo exist within the stand.	**Objectives:** • Shift species composition toward drought-resistant, shade-intolerant species. • WUI: Decrease potential surface fire intensity via reduced surface fuels. • WUI: Reduce potential for crown fire by reducing canopy continuity. • WUI: Stimulate aspen regeneration to reduce potential fire intensity	Coppice treatment to remove tree species in patches within the entire stand. Pile burn as needed to reduce fuels, provide areas for regneration and as directed by design features. Broadcast burn in and around mixed conifer stands with an aspen component depending on site conditions.	Remove spruce-fir / conifer and allow stand to succeed to aspen dominated stand. Pile burn as needed to reduce fuels, provide areas for regneration and as directed by design features. Broadcast burn in and around mixed conifer stands with an aspen component depending on site conditions.	Depends upon on-the-ground conditions (e.g. multi-storied, live under-story above average snow depth, etc.). Harvest possibly tracked under VEG S1, S2 and / or VEG S6.	Remove spruce and fir to favor shade-intolerant conifer species and aspen. Prescribed burning in these types of stands may include pile burning and broadcast burning. Prescribe burn unit treatment area could be larger than the target stand in order to utilize adequate fire control lines – roads, trails, natural fuel breaks and constructed fire lines.

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APPENDIX B – DESIGN FEATURES

Spruce Beetle Epidemic and Aspen Decline Management Response

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Introduction

The design features were developed from laws, regulations, Forest Service Manual or Handbook policy, standard contract language, Forest Service-approved best management practices, or Forest Plan guidelines. These items are considered to be standard management practice as provided by the aforementioned sources, as they have been proven effective during implementation of similar vegetation treatments as proposed in this DEIS. These features derive from decades-long practices and/or more recent best available science. These design features translate legal provisions and scientific principles into solid, commonsense stewardship actions that support continued sustainable resource use (USDA Forest Service 2006). They are listed by the functional area from which they arise.

During planning of a particular treatment authorized under the EIS, an interdisciplinary team (IDT) would be used to complete required surveys in accordance with Forest Plan and Region 2 policy requirements. The IDT would also complete treatment layout, including treatment units, location of roads, skid trails and landings, and identifying water influence zones. The team would also identify applicable treatment design features that would be applied to the treatment area. The Pre-Treatment Checklist, Appendix C, would be used to document completed work. Forest Service staff specialists would sign off on completed work before it would be approved by the District Ranger.

Design features would be subject to change as a result of 1) change in policy or management direction (e.g. amendments or revision of the Forest Plan, federal listing of a species, etc.) and 2) new science which indicates design feature should be modified or replaced to improve effectiveness. Potential changes would be evaluated during annual Management Reviews of SBEADMR implementation.

Identifier	Design Feature	Source / Citation
Air Quality **Objectives:** Comply with Clean Air Act requirements.		
AQ-1	Prescribed burning operations will comply with the State of Colorado air quality regulations.	Clean Air Act
(TSHR-7)	Use suitable road surface stabilization practices and dust abatement supplements on roads with high or heavy traffic use (See FSH 7709.56 and FSH 7709.59).	FS National BMPs

Cultural Resources

Objectives:

The following Cultural Resources Design Features derived from the Programmatic Agreement will be implemented for Alternatives 2, 3 and 4. If these standard treatments are followed as described above, the proposed treatment will have no direct or indirect effects on cultural resources. Furthermore, under the SBEADMR S.106 Notification consultation with the Colorado State Historic Preservation Officer will have no adverse effect on historic properties (Claeyssens 2014).

CR-1	Cultural resource surveys will occur prior to treatment implementation. All sites within a treatment area will be avoided until State Historic Preservation Office consultation may be completed.	2010 Programmatic Agreement for Bark Beetle, Hazardous Fuel and Tree Reduction Programs
CR-2	Discoveries: If any new cultural resource sites are discovered during implementation, treatment activities would stop and the Forest Service archeologist would be contacted immediately. The archaeologist will evaluate the significance of the cultural resource. If potentially significant, within 48 hours of the discovery, the SHPO will be notified of the discovery and consultation will begin to determine an appropriate mitigation measure. The discovery will be protected from further disturbance until any required mitigation is completed. Operations may resume at the discovery site upon receipt of written instructions and authorization by agency officials.	2010 Programmatic Agreement for Bark Beetle, Hazardous Fuel and Tree Reduction Programs
CR-3	For all cultural resource sites located during the field inventory or previously known, no mechanical treatment or ground disturbing activities will occur within the site boundary, including an additional 50 foot buffer around the site. If mechanical treatments are necessary, the site and the 50 foot buffer around the site will be treated by hand to remove hazard trees and accumulated fuel build up.	Stipulation 5.B.b. ii and Stipulation 6.a and6 .b, Standard Treatments for Historic Properties, in the 2010 Programmatic Agreement for Bark Beetle, Hazardous Fuel and Tree Reduction Programs
CR-4	In areas slated for prescribed fire treatment, flammable cultural resource sites or sites with components or features susceptible to heat damage with the APE will be marked on the ground by an archeologist, along with a buffer area of no less than 50 feet, sufficient to prevent fire or heat from affecting components of the site that may contribute to its eligibility to the National Register of Historic Places. In addition, treatments may include fuel-breaks, no-treatment buffers, wrapping, foaming, wetting, blackline, fire line (hand or mechanical), and clearing the cultural resource sites of flammable debris by raking and hand removal. Any fire line that will be ground disturbing will be subjected to an intensive field inventory; if any additional sites, components or features are located, the fire line will be adjusted to avoid these cultural resources.	GMUG's 2013 Prescribed Fire Programmatic Agreement
CR-5	If road construction cannot physically be relocated to avoid a site, and there is the potential for unidentified buried cultural remains, then SHPO consultation will take place and construction activities in the site boundaries would be monitored by an archaeologist.	GMUG's 2013 Prescribed Fire Programmatic Agreement
CR-6	Culturally Scarred Trees (CSTs) will be protected during mechanical treatments and to the extent possible, during underburns. Hand removal of fuels under CSTs will be conducted to the extent possible to reduce the risk of killing them during prescribed burning. However, no measures will be taken to create firelines or physically prevent burning around the CSTs.	GMUG's 2013 Prescribed Fire Programmatic Agreement

CR-7	Post-Treatment Monitoring: For treatments where field inventories are not feasible due to visibility concerns prior to treatment implementation, monitoring in the form of a sample inventory for cultural resources will be required post implementation. This monitoring will take place within one year of treatment implementation, with results provided to SHPO.	GMUG's 2013 Prescribed Fire Programmatic Agreement
CR-8	Post-Treatment Monitoring: Cultural resource sites that were required to be avoided during treatment implementation will be monitored for effectiveness of the protection measures following treatment completion.	GMUG's 2013 Prescribed Fire Programmatic Agreement
CR-9	Native American human remains: Any operator carrying out treatments must notify the Forest Service, by telephone, with written confirmation, immediately upon the discovery of human remains or funerary items, discovered on federal land. The Forest Service must then immediately notify appropriate tribes of the find. All treatment activities must stop in the vicinity of the discovery that could adversely affect it, until tribal consultation can be completed and a Plan of Action can be approved and implemented	NAGRPA regulation 43 CFR 10.4(g)

Forest Service Sensitive Plants

Objectives:

1. For Upland (non-wetland) Sensitive Species: Minimize impacts to individuals or populations that would lead to a loss in viability.
2. For all Sensitive Species: Minimize impacts to individuals or populations that would contribute to a loss in viability.
3. For Fen Sensitive Species*:
   a. Reduce potential for recreation-related resource damage to fens.
   b. Maintain fen hydrologic function (soil compaction, water diversion, dewatering) that would reduce suitability or sustainability of rare fen habitat.
   c. Prevent sedimentation events that would reduce or impair wetland functions.
4. For *Astragalus leptaleus*: Maintain functions of riparian wet or moist meadows.

**Carex diandra, Drosera rotundifolia, Eriophorum altaicum var. neogaeum, E. chamissonis, E. gracile, Kobresia simpliciuscula, Salix candida, Sphagnum angustifolium, Utricularia minor*

FSSP-2	**All Sensitive Species** A - During prescribed fire operations (including aerial or ground broadcast burning), ignitions and other fuel treatment activities would be located away from sensitive plant species occurrences and wetlands. B - Dust abatement (use of $MgCl_2$ or $CaCl_2$) will avoid sensitive species occurrences and wetlands by 500 feet. C - Avoid sensitive species occurrences and wetlands with chemical weed treatments. E - Any Region 2 sensitive plant species new to list or located after contract or permit issuance will be appropriately managed by active coordination between permittee, contractor or purchaser, Forest Service line officer, treatment administrator, and botanist.	Elliott and others 2011, treatment- specific design
FSSP-3	***Machaeranthera coloradoensis*** A - Minimize use of roads passing through known sensitive species sites.	Elliott and others 2011, treatment- specific design

FSSP-4	***Botrychium lineare, B. paradoxum*** B - If there is tree canopy covering habitat, maintain pre-treatment tree canopy over habitat.	Elliott and others 2011, treatment- specific design
FSSP-5	**Fen sensitive species*** A - During treatment, temporary roads will be signed and effectively closed to the public if near a wetland.	
FSSP-6	**Fen sensitive species*** A - Keep roads and trails out of wetlands and their water influence zones (WIZ). (1)B - Restore existing disturbed areas that are eroding and contributing sediment to the wetland. (WQSP-6A) – No mechanical equipment will be used within 100 feet of the edge of a fen.	(1) USDA Forest Service 2006. (2) USDA Forest Service 2006, 2012.
FSSP-7	**Fen sensitive species*** A – Treatment activities will avoid wetlands B – Mechanical treatment and vehicle use will occur outside of wetlands or their water influence zones. C- Prevent mineral sediment deposition from occurring in wetlands. (3)	(3) USDA Forest Service 2012, Austin 2008.
FSSP-8	**Fen sensitive species*** A - Develop an erosion and sediment control plan to avoid or minimize downstream impacts using measures appropriate to the site and the proposed activity. (3) B - Conduct prescribed fires to minimize the residence time on the soil while meeting the burn objectives. This is usually done when the soil and duff are moist. C - Limit roads and other disturbed sites to the minimum feasible number, width, and total length. Minimize sediment discharge into streams, lakes, & wetlands during construction and stabilize & maintain disturbed sites to control erosion. (1) D - Maintain sufficient upslope ground cover to prevent sediment movement downward into wetland.	1) USDA Forest Service 2006. (3) USDA Forest Service 2012, Austin 2008.
FSSP-9	*Astragalus leptaleus* A - Avoid treatment activities and equipment use in wet or moist meadows. B - Design stream crossings at armored points, or armor them to prevent loss of functions in wet or moist meadows.	Elliott and others 2011, treatment- specific design
Invasive Weeds **Objective:** Prevent new introductions of weeds or spread of existing infestations.		
IW-1	A - Consider excluding areas from prescribed burning where there are infestations of fire-proliferating species (example, cheatgrass).	

IW-2	**Practices** - Prevent the accidental spread of invasive species carried by contaminated vehicles, equipment, personnel, or materials. (2) A - Establish and implement standards and requirements for vehicle and equipment cleaning to prevent the accidental spread of aquatic and terrestrial invasive species on the treatment area. (1) Use standard timber sale contract provision WO-CT 6.36 to ensure appropriate equipment cleaning. Equipment cleaning should be conducted after working in areas with known infestations, and prior to bringing equipment onto the National Forest. B - Locate and use weed- free treatment staging areas. Avoid or minimize all types of travel through weed- infested areas, or restrict to those periods when spread of seed or propagules are least likely. (3) C - Workers need to inspect, remove, and properly dispose of weed seed and plant parts found on their clothing and equipment. Proper disposal means bagging the seeds and plant parts and incinerating them. (3) D - All imported materials (erosion control materials, soil, gravel, etc.) should be from a "weed-free" source or area.(3) E - Monitoring will occur where imported materials have been placed to ensure no new infestations have been established.	(1) Noxious weeds, that appear on the State of Colorado's noxious weed list (Colorado 2013) (2) FSM 2900. (3) USDA Forest Service 2001.
IW-3	**Practices** - Retain native vegetation to the extent possible to prevent weed germination and establishment, in and around activity area and keep soil disturbance to a minimum. (3) A - Timber purchasers and contractors will re-seed disturbed areas (as designated by the Forest Service) with an appropriate certified weed-free native seed mix (USDA Forest Service 2008) to avoid introduction of nonnative invasive plants and promote re-vegetation of native species. B - Throughout the implementation period of the proposed action, the Forest Service should maintain flexibility to defer cut units or stands within priority areas from treatment due to the discovery of significant new invasive plant populations with potential to disrupt the functioning of native plant communities. C - Where fuel reduction, timber harvest and other resource objectives necessitate ground disturbance and soil exposure, or substantial ground cover and canopy removal, include appropriate re-vegetation or invasive plant management strategies in treatment plan. (4) Where necessary, rehabilitate/restore or treat disturbed areas after management activities and conduct follow up monitoring on these areas susceptible to invasive plant spread. (4) D - Rehabilitate/restore or treat disturbed areas after fuel management activities and conduct follow up monitoring on these areas susceptible to invasive plant spread. (4) E - Cover and reduce exposure of bare ground. Use on-site chipping or treated fuels from mastication to cover bare soil to prevent seed establishment where appropriate. (4) See SV-4 concerning areas where mineral soil exposure would be needed to assist with natural regeneration. F- Slash and burn piles will be located away from known invasive plant populations and will be assessed for restoration and revegetation needs.	(3) USDA Forest Service 2001. (4) From Cal-IPC Land Management BMPs

IW-4	**Practices** - Control and treat existing infestations to prevent treatment-associated spread and proliferation. A - Coordinate treatment activities with any nearby herbicide application to maximize cost effectiveness of nonnative invasive plant treatments. (3) B - Treatment of noxious weeds will follow Forest Service policy regarding certification of applicators and reporting of data to Forest Service data bases. C - Treatments of noxious weeds will follow the District Noxious Weed Treatment Decision Notice. D - Populations of noxious weeds should be aggressively treated with the appropriate management tools. This may include treatment with herbicides, grazing, cultural, and biological methods, consistent with the GMUG district decision notices.	(3) USDA Forest Service 2001.
Lands **Objectives:** 1. Avoid impacts to existing infrastructure from treatment activities. 2. Ensure treatments near electric infrastructure are conducted safely.		
L-1	Mechanical treatments used to remove dead and dying vegetation shall utilize equipment or operating techniques to ensure that debris cannot be thrown into electrical facilities causing damage or safety hazards.	Professional judgment
L-2	Coordinate prescribed fire treatment activities with utility ROW holders to ensure that facilities are not damaged by a fire that burns too hot or generates smoke dense enough to disrupt the transmission of electricity.	Professional judgment
L-3	When conducting hand treatments near energized facilities, non-electrical workers will observe the minimum approach distance.	Occupational Safety and Health Administration regulations provided in 29 CFR §1910.333.

Range **Objectives:** 1. Eliminate conflicts between implementation activities and range activities, or mitigate for them. 2. Revegetate sites disturbed during implementation.		
RG-1	Coordinate with District Rangeland Management Specialists prior to developing sale and/or service contracts and/or burn plans to identify and mitigate any potential direct conflicts during implementation. Range personnel will be responsible for incorporating mitigation measures into grazing permittees' Annual Operating Instructions (for example, a pasture needs to be grazed earlier/later to avoid direct temporal overlap with timber sale activities).	GMUG Forest Plan
RG-2	Coordinate with District Rangeland Management Specialists prior to treatment to determine whether or not grazing deferment or pasture rest is needed, when deferment or rest is needed (prior to or following treatment), and for how long.	Professional judgment
(IW-5)	Re-seeding: See IW-5.	
Recreation **Objectives:** 1. Coordinate potential conflicts between timing of treatment implementation and recreation use. 2. Seek opportunities to design treatments to benefit recreation residences, lodges, and organization camps in the vicinity of planned treatments.		
REC-1	Avoid use of broadcast burning or piling and burning treatments in campgrounds.	Professional judgment
REC-2	Developed recreation sites: Managed by concessionaire: plans need to consider impact to summer operating season and should minimize impacts to operations as much as possible. For Forest Service operated sites: coordinate with District to address any District concerns regarding impact to the operating season.	Professional judgment
REC-3	Coordinate with District recreation staff regarding any treatment-related closures for developed recreation sites, dispersed recreation sites, trails and roads.	Professional judgment

REC-4	Special Uses: Work with recreation residences, lodges and organization camps to design treatments adjacent to these tracts to also treat these tracts to the extent feasible. Coordinate with District recreation staff to address treatment-related impacts to special use permit holders in the treatment area.	Professional judgment

Scenic Quality and Visual Resources

Objectives:

VQOs of Preservation (P) – only ecological changes are allowed. Management activities, except for very low visual-impact recreation facilities, are prohibited. This objective applies to Wilderness areas, primitive areas, other special classified areas, areas awaiting classification and some unique management units which do not justify special classification.

VQOs of Retention (R) – management activities must not be visually evident. They may only repeat form, line, color and texture which are frequently found in the characteristic landscape. Changes in their qualities of size, amount, intensity, direction, pattern, etc., should not be evident. Immediate reductions of contrast should be accomplished by means such as seeding vegetative clearing and cut-and-fill slopes, hand planting of large stock, painting structures, etc.

VQOs of Partial Retention (PR) – management activities must remain visually subordinate to the characteristic landscape. Activities may repeat form, line, color or texture common to the characteristic landscape. Changes in their qualities of size, amount, intensity, direction, pattern, etc., remain visually subordinate to the characteristic landscape. Actions may also introduce form, line, color, or texture which are found infrequently or not at all in the characteristic landscape, but should remain subordinate to the visual strength of the characteristic landscape. Reduction of contrast in form, line, color and texture to meet partial retention should be accomplished as soon as possible orwithin a year minimum.

VQOs of Modification (M) – management activities may visually dominate the original characteristic landscape. However, activities of vegetative and landform alteration must borrow from naturally established form, line, color or texture so completely and at such a scale that its visual characteristics are those of natural occurrences within the surrounding area or character type. Activities are predominantly introduction of facilities such as buildings, sighs, roads, etc. Reduction of contrast (or compliance with regional guidelines) should be accomplished in the first year.

VQOs of Maximum Modification (MM) – management activities may dominate the original characteristic landscape. However, when viewed as a background, the visual characteristics must be those of natural occurrences within the surrounding area or characteristic type. When viewed as foreground or middle ground, they may not appear to completely borrow from naturally established form, line, color or texture. Alterations may also be out of scale or contain details incongruent with natural occurances as seen in the foreground or middle ground. Activities are typically additional part of structures, roads, slash and root wads must be subordinate to proposed composition as viewed in the background. Reduction of contrast should be accomplished within five years.

Volume Two, Chapter 1: The Visual Management System, National Forest Landscape Management, Handbook 462, (Big Eye Book) pp 29 -- 37, .pdf, 4.08 MB

SVR-1	In developed recreation sites, including trailheads and administrative sites (typically Visual Quality Objectives [VQOs] of Modification or Maximum Modification), cut stumps as low to the ground as feasible. Remove or chip slash at developed campgrounds or designated recreation areas; extending outwards 200 feet of any constructed feature; at designated dispersed sites; and other dispersed sites deemed important at the time of implementation. Alternatively, at designated dispersed sites or other dispersed sites deemed important and at developed recreation sites (except developed campgrounds or designated recreation areas) and at administrative sites, move heavy slash to designated slash piles and burn as soon as conditions allow. Note: designated recreation areas include but are not limited to: Taylor Canyon, Mesa Lakes, Island Lake, and Amphitheatre/Na-Gach.	USDA Forest Service 2008. *Hazardous Tree Removal Project, Medicine Bow – Routt National Forests.* J. Tupala. Laramie, Wyoming; and Treatment- Specific Design in consultation with GMUG staff.
SVR-2	In developed recreation and administrative sites (typically VQOs of Modification or Maximum Modification), minimize damage, resulting from mechanical treatments, to mature trees already sprayed with insecticide for protection from bark beetle attack; and to young healthy trees and understory trees and shrubs. Protect to provide present and future shade and screening, and to maintain high quality recreational setting and desired scenic condition.	
SVR-3	In areas of VQO Pristine or Preservation, where feasible, fresh cut ends of logs that are felled, but not removed, will be moved away from the trail. When cutting trees that fall across trails or within the trail corridor (generally 3 feet on either side of the trail), lop and scatter logs and limbs outside the corridor and remove heavy slash in the foreground and mid-ground (approximately 300 feet from edges) of roads and trails.	
SVR-4	In areas of Retention or Partial Retention, minimize damage to natural features such as rock outcrops, young healthy trees and understory of trees and shrubs; cut stumps as low to the ground as feasible. Note: Retention and Partial Retention should be applied to National Recreation Trails, National Scenic Trails, National Historic Trails and State or Forest Service Scenic Byways/All-American Roads.	
SVR-5	Revegetate and till disturbed and compacted soils on landings, burned slash pile sites, skid trails and temporary roads with native seed mixture after the completion of treatments to reduce soil contrast. Block access to decommissioned roads with naturalistic barriers to encourage regrowth.	
SVR-6	All designated trails (NRT, NST and NHT) and scenic byways must have heavy slash within the immediate foreground (not less than 25 feet from edges of roads and trails) removed to slash piles or chipped.	

Silviculture

Objectives:

1. For spruce beetle-affected stands:
    a. Provide for salvage of dead or dying stands
    b. Maintenance of green stands where they exist
    c. Regenerate stands where needed.
2. For stands to be treated for aspen decline:
    a. Regeneration of aspen before advanced decline, by either fire or mechanical removal
    b. Increase landscape resilience of aspen by ensuring that there are significant patches of young aspen
    c. Provide for aspen establishment

SV-1	All regeneration cutting will meet stocking standards as defined in the Forest Plan.	1991 Forest Plan
SV-2	All vegetation treatments, including prescribed fire, will be prescribed by a U.S. Forest Service, Region 2, Certified Silviculturist in accordance with applicable guidance from other resource specialists.	FSH 2409.17 Silvicultural Practices handbook
SV-3	To the greatest degree practicable given site fuels conditions, jackpot and pile burning would be used as acceptable methods to assist with natural regeneration strategies. Burning could be prescribed to create mineral soil seedbeds for natural regeneration. Harvested areas would be evaluated for stocking	R-2 FSH 2409.17 Silvicultural Practices Handbook
SV-4	During site preparation or piling activities, mineral soil exposure will be less than 40% of the treated area. Soil cover should be retained when practicable. To assist natural regeneration, conduct vegetation and fuels management activities to average 20 - 40% mineral soil exposure in post-harvest, as prescribed in the stand management prescription. On south slopes, mineral soil exposure would be less so that site moisture can better be retained. If the area has been identified as being high risk for invasive plants, or is known to have existing infestations, reduce soil exposure and consider artificial regeneration practices (planting).	Alexander 1987
SV-5	In order to reduce the risk of spruce beetles being drawn to uninfected trees, in stands with a component of live spruce which are not beetle-infected, felled spruce shall be removed from the sale area by no later than October 31 of the year felling occurs and unutilized spruce material (in excess of the 10-20 tons/acre required by the Forest Plan) that is cut during operations and greater than 6" diameter at the small end, but is not merchantable and left on site could be removed from the stand and taken to the landing. This will be considered yarding of un-merchantable material (YUM). When removal of non-merchantable material (YUM) is operationally infeasible, material would be debarked in stands, chipped or otherwise treated within the stand to reduce the likelihood of the material being utilized as brood material. Treatment of non-merchantable material will be prescribed by a certified silviculturist based on site specific conditions, with the overall goal being to reduce brood material.	Professional judgment of GMUG silviculturists and Forest Health Protection Staff.
SV-6	During any types of harvest in spruce-fir, pockets or areas of advanced regeneration will avoided to the greatest degree practicable protect advanced regeneration.	Professional judgment and standard operating procedure used by GMUG silviculturists.

SV-7	Broadcast burning for regeneration of spruce-fir stands should be limited to salvage operations in stands with almost total spruce mortality where limited advanced regeneration is left, or anticipated to be left after harvest in order to avoid negative impacts of fire to live spruce. Targets for broadcast burning for regeneration in salvage harvested spruce-fir stands would be creating patches of exposed mineral soil in up to 40% of the area to allow for spruce seed establishment mixed with some large residual material to provide shade to seedlings and seed sources within 300 feet of a majority of the unit. If the area has been identified as being high risk for invasive plants, or is known to have existing infestations, reduce bare mineral soil exposure and consider artificial regeneration practices (planting).	Professional judgment of GMUG silviculturists; Fire Effects Information System; Kilgore and Curtis 1987.
SV-8	In stands managed for aspen regeneration: a. Treatment units > 20 acres are preferred, to lessen effects of big game and livestock browsing. b. Minimize soil compaction by heavy equipment and haul trucks. c. Confine aspen treatments to suitable soils as much as possible. d. Give preference to sites in threatened and persistent aspen habitat zones (Worrall 2013). e. Use clear-felling (with fire as appropriate) to regenerate aspen stands for increased landscape resilience f. Choose timing of treatments, appropriate to recent extreme weather events.	Johnston 2001, Worrall 2013, Worrall et al. 2013
(RG-2)	Coordinate with District Rangeland Management Specialists prior to treatment to determine whether or not grazing deferment or pasture rest is needed, when deferment or rest is needed (prior to or following treatment), and for how long.	Professional judgment of GMUG silviculturists and rangeland management specialist.
(SP-1)	If the treatment unit is <100 acres and not near infrastructure or in management areas 1A, 1B or 1D, and aspen regeneration is the main goal, slash may be left on the ground to deter elk browse of aspen seedlings.	Professional judgment and standard operating procedure used by GMUG fuels managers.

Slash Piles

Objectives:

1. Use current science and silvicultural, fuels and fire management practices to achieve an optimum balance between positive and negative effects of slash treatment on soils, hydrology, wildlife and potential fire risk.
2. Reduce negative impacts of fires.

SP-1	If the treatment unit is <100 acres and not near infrastructure or in management areas 1A, 1B or 1D, and aspen regeneration is the main goal, slash may be left on the ground to deter elk browse of aspen seedlings.	Professional judgment and standard operating procedure used by GMUG fuels managers.
SP-2	A minimum and maximum fuel loading will be specified in association with harvests and fuels treatments. Generate associated Brush and Disposal (BD) plan. This minimum and maximum will include any needs to reduce fuels near infrastructure and leave material onsite for seedling establishment, wildlife benefit and soils health.	Standard operating procedure used by GMUG silviculturists and fuel managers.

SP-3	In Management Areas 1A, 1B and 1D, (developed recreations sites, ski areas, utility corridors) enough harvest/activity-generated fuels will be removed so that residual fuel loading produce less than four foot flame lengths under 90% burning conditions . Slash piles will be burned by the Forest Service in accordance with agency protocols.	1991 Forest Plan Amendment, 8224GM, p III-91, III-95, III-99 and standard operating procedure used by GMUG silviculturists.
SP-4	To keep impacts to soils (sterilization) to a minimum pile size should be limited as follows. Piles at landings, where soils are impacted by previous yarding and loading, can be up to 20-30' in diameter, or 400-900 square feet. Piles in interior areas of treatment units, where soils are less disturbed, should be limited to 10-20' in diameter (100-400 square feet). Attempt to keep total area covered by piles/acre under ~5% (<2,500 square feet/acre covered by piles). Too many small piles (<10' diameter) results in inefficiency in burning them. Where landing piles are burned the previously impacted soils should be rehabilitated by scarification following burning. When possible do not place green material exceeding 8" in burn piles. If practicable design treatments so activity fuels larger than 8" are removed from the site. If piles are created by a bulldozer, use a brush rake to avoid collecting soil and duff in the burn pile. Piles should be spaced adequately away from leave trees to reduce damage to trees during burning.	Professional judgment and standard operating procedure used by GMUG silviculturists and fuels managers.
SP-5	In areas treated for recovery where beetle kill is prominent, piles will be burned as soon as burn conditions for pile burning occur (usually first adequate snowfall event). Piles will need to be located in proximity to roads that prescribed burn personnel can reach the site either by motorized vehicle (truck, UTV, ATV, or snowmobile) or by foot without having to hike or ski more than ¼ to ½ mile to reach the piles.	Professional judgment and standard operating procedure used by GMUG silviculturists and fuels managers.
SP-6	Activity generated fuels would be reduced in compliance with the treatment Brush and Disposal (BD) plan. Fuels, silviculture and timber resources management personnel would develop prescriptions considering economical harvest methods, activity fuels and residual site conditions.	FSH 2409.19
Transportation System and Haul Routes **Objectives:** Manage travel management effectively to provide resource protection and a safe, environmentally sound, and efficient transportation system.		
TSHR-1	Existing roads will be used for equipment access to the extent road location and condition permit reasonable access. Implementation of mechanical treatments and harvests will attempt to minimize road construction whenever possible.	2006 Watershed Conservation Practices Handbook and treatment-specific design

TSHR-2	New Access Roads: Where terrain, road length, and other resource risks exist, a "Designed Road" shall be utilized for Treatment access. Designed Roads would be surveyed, designed, and administered by the Forest Service engineering department. Designed Roads may, in rare circumstances, become National Forest System roads if needed for long-term access and utilization, or they will be subsequently decommissioned if only needed for temporary treatment access. The District Ranger shall be responsible for determining whether a designed road is to be added to the Forest transportation system. Temporary roads may be used where a designed road is not needed, as determined by the Forest Service. The location and clearing widths of all Temporary Roads or facilities shall be agreed to in writing (between the Forest Service and the contractor) before construction is started. Following use for harvest and treatment implementation, temporary roads will be decommissioned, which involves recontouring where significant sideslope exists, elimination of ditches and other structures, outsloping the roadbed, removal of ruts and berms, effectively blocking the road to normal vehicular traffic where feasible, and construction of drainage features such as cross ditches and water bars. Invasive species monitoring will occur after road decommissioning and will be followed by weed treatments where needed. Effectiveness of road closure will also be monitored.	Treatment- specific design Timber Sale Contract Standard Provisions (Contract FS-2400-6, USDA Forest Service 2006)
TSHR-3	Require commercial haulers to perform maintenance commensurate with their use; depositing sufficient funds with the Forest Service may be used in lieu of performance. Surface rock replacement deposits will be collected to maintain currently surfaced roads that are used for timber hauling. Deposits will be collected commensurate with the use. Quarry materials will be collected from a site that has been found to be free of invasive plants.	FSM 7732.03
TSHR-4	Timber hauling operations will be restricted during wet or thawed conditions, when needed to protect the road surface.	FS National BMPs; Treatment- specific design
TSHR-5	Safety signing will be used to alert the public that logging operations are in progress and would meet the requirements of the Manual of Uniform Traffic Control Devices (MUTCD).	Timber Sale Contract Standard Provisions (Contract FS-2400-6, USDA Forest Service 2006); FSM 7160
TSHR-6	Use of private roads, encroachment of public roads and rights-of-way, and other access needs outside Forest Service jurisdiction shall have the proper approval or authorization in place prior to use.	16 U.S.C. 572; treatment-specific design
TSHR-7	Use suitable road surface stabilization practices and dust abatement supplements on roads where road surface conditions, traffic use and proximity to recreation or public occupancy justify the need . (See FSH 7709.56 and FSH 7709.59).	FS National BMPs
TSHR-8	Move snow in a manner that will avoid or minimize disturbance of or damage to road surfaces and drainage structures. Use existing standard contract language (C5.316# or similar) for snow removal during winter logging operations to avoid, minimize, or mitigate adverse effects to soil, water quality, and riparian resources.	FS National BMPs

Water Quality and Soil Productivity

Objectives:

1. Manage treatments to maintain ground cover to prevent harmful increases in runoff.
2. In the Water Influence Zone (WIZ) next to perennial & intermittent streams, lakes, and wetlands, allow only those actions that maintain or improve long-term stream health and riparian ecosystem condition
3. Design and construct all stream crossings and other in-stream structures to provide for passage of flow and sediment, withstand expected flood flows, and to allow free movement of resident aquatic life.
4. Maintain long-term ground cover, soil structure, water budgets, and flow patterns of wetlands to sustain their ecological functions.
5. Limit roads and other disturbed sites to the minimum feasible number, width, and total length.
6. Construct roads and other disturbed sites to minimize sediment discharge into streams, lakes, & wetlands.
7. Stabilize and maintain roads and other disturbed sites during and after construction to control erosion.
8. Reclaim roads, landings and other disturbed sites when use ends, as needed, to prevent resource damage.
9. Manage land treatments to limit the sum of severely burned soil and detrimentally compacted, eroded, and displaced soil to no more than 15% of any activity area.

The following design features to protect watershed resources are based on, and structured according to the Region 2 Watershed Conservation Practices Handbook. They address conditions or circumstances that have occurred on recent GMUG NF timber sales. Additional BMPs in the R2 Handbook or National Handbook may apply within future treatment areas as determined during treatment-specific assessments. The various measures may be achieved through avoidance, on-the-ground marking, appropriate contract provisions, identification on the sale or service area map, and/or during sale or contract administration.

Treatment-specific soils, hydrologic, and watershed condition assessments will be performed prior to any on-site work (see Appendix B). Treatment-specific design features will be selected based on treatment tasks and the results of treatment-specific assessments.

WQSP-1	A. Maintain the organic ground cover of each activity area so that pedestals, rills, and surface runoff from the activity area are not increased. The amount of organic ground cover needed will vary by different ecological types and should be commensurate with the potential of the site. B. Restore the organic ground cover of degraded activity areas within the next plan period, using certified local native plants as practicable; avoid persistent or invasive exotic plants.	USDA Forest Service 2006

WQSP-2	A. The minimum horizontal width of the Water Influence Zone for various water related features is as follows: **Feature** / **Outside Edge of WIZ** / **No Harvest or Mechanical Travel Zone** Fens and their associated wetlands / 100 ft minimum from edge of fen / 100 ft from edge of fen Perennial Streams / 100 ft. from stream bank / 50 ft from stream bank Intermittent Streams, Reservoirs and Ponds / 50 ft. from bank or high water line / 25 ft from bank or high water line Wetlands ≥ ¼ acre / 100 ft. from edge of wetland / 50 ft from edge of wetland Springs/Seeps/Wetlands/ depressional recharge areas < ¼ acre / 50 ft. from the source or edge of associated wetland, whichever is greater / 25 ft from the source of edge of associated wetland, whichever is greater Ephemeral Streams and Swales / 25 ft from the channel or topographic low / Ditch / Edge of Right of Way / B. Keep heavy equipment out of streams, swales, and lakes, except to cross at designated points, build crossings, or do restoration work, or if protected by at least 1 foot of packed snow or 6 inches of frozen soil. Keep heavy equipment out of streams during fish spawning, incubation, and emergence periods. C. Ensure at least one-end log suspension in the WIZ. Fell trees in a way that protects vegetation in the WIZ from damage. Keep log landings and skid trails out of the WIZ, including swales. D. Locate new concentrated-use sites outside the WIZ if practicable and outside riparian areas and wetlands. Armor or reclaim existing sites in the WIZ to prevent detrimental soil and bank erosion. E. Do not excavate earth material from, or store excavated earth material in, any stream, swale, lake, wetland, or WIZ. F. Maintain at least 80 percent of potential ground cover within the WIZ G. Burn piles may be located within the outer half of WIZs but must not cover more than 15% of the ground. H. Avoid direct ignition of prescribed fire within WIZs. Prescribed fire may be allowed to back in to these areas.	USDA Forest Service 2006, Management Prescription 09A in 1991 Forest Plan, and treatment-specific design

WQSP-3A	A. Install stream crossings to meet Corps of Engineers and State permits, pass normal flows, and be armored to withstand design flows. B. Size culverts and bridges to pass debris. Engineers work with hydrologists and aquatic biologists on site design. C. Install stream crossings to sustain bankfull dimensions of width, depth, and slope and keep streambeds and banks resilient. Favor bridges, bottomless arches or buried pipe-arches for those streams with identifiable flood plains and elevated road prisms, instead of pipe culverts. Favor armored fords for those streams where vehicle traffic is either seasonal or temporary, or the ford design maintains the channel pattern, profile and dimension.	USDA Forest Service 2006
WQSP-3B	Where access across the WIZ must be provided by temporary roads, they will be completely decommissioned by obliteration after harvest is complete. Obliteration at crossings will include the removal of culverts & fill material, the re-contouring of stream banks to the original landform shape, and seeding & mulching of the disturbed surfaces. The remaining prism within the WIZ shall be de-compacted, seeded, and mulched.	Management Prescription 09A, 1991 Forest Plan, and treatment-specific design
WQSP-4	A. Keep ground vehicles out of wetlands. Do not disrupt water supply or drainage patterns into wetlands. B. Keep roads and trails out of wetlands. Avoid actions that may dewater or reduce water budgets in wetlands. C. Avoid any loss of rare wetlands such as fens and springs. D. Do not build firelines in or around wetlands unless needed to protect life, property, or wetlands. Use hand lines with minimum feasible soil disturbance. Use wetland features as firelines if practicable.	USDA Forest Service 2006, Executive Order 11990, and treatment-specific design
WQSP-5A	Manage land treatments to limit the sum of severely burned soil and detrimentally compacted, eroded, and displaced soil to no more than 15% of any activity area.	USDA Forest Service 2006.
WQSP-5B	A. Avoid soil-disturbing actions during periods of heavy rain or wet soils. Apply travel restrictions to protect soil and water. B. Install cross drains to disperse runoff into filter strips and minimize connected disturbed areas. Make cuts, fills, and road surfaces strongly resistant to erosion between each stream crossing and at least the nearest cross drain. Revegetate using certified local native plants as practicable; avoid persistent or invasive exotic plants. C. Use existing roads unless other options will produce less long-term sediment. Reconstruct for long-term soil and drainage stability. D. Avoid ground skidding on sustained slopes steeper than 40% and on moderate to severely burned sustained slopes greater than 30%. Conduct logging to disperse runoff as practicable. E. Locate and construct log landings in such a way to minimize the amount of excavation needed and to reduce the potential for soil erosion. Design landings to have proper drainage. After use, treat landings to disperse runoff and prevent surface erosion and encourage revegetation.	USDA Forest Service 2006 and treatment-specific design
WQSP-6	A. Design all roads, trails, and other soil disturbances to the minimum standard for their use and to "roll" with the terrain as feasible. B. Use filter strips, and sediment traps if needed, to keep all sand-sized sediment on the land and disconnect disturbed soil from streams, lakes, and wetlands. Disperse runoff into filter strips.	USDA Forest Service 2006 and treatment-specific design

<table>
<tr><td>WQSP-7A</td><td>A. Do not encroach fills or introduce soil into streams, swales, lakes, or wetlands.
B. Space cross drains according to road grade and soil type as indicated below: (ex. 01). Do not divert water from one stream to another.
C. Empty cross drains onto stable slopes that disperse runoff into filter strips. On soils that may gully, armor outlets to disperse runoff. Tighten cross-drain spacing so gullies are not created.
D. Where berms must be used, construct and maintain them to protect the road surface, drainage features, and slope integrity while also providing user safety.</td><td>USDA Forest Service 2006 and treatment-specific design</td></tr>
<tr><td>WQSP-7B</td><td>A. Skid trail locations will be agreed to by the Forest Service in advance of construction; spacing will be approximately 100 feet apart, allowing for topographic variation and skid trail convergence. Space water bars as appropriate on skid trails according to slope and soil type as indicated below:
<table>
<tr><th colspan="5">Unified Soil Classification - ASTM D 2487[1]</th></tr>
<tr><th>Slope (%)</th><th>ML, SM
<u>Extremely Erodible</u>
Silts &sands with little or no binder (i.e. decomposed granite)</th><th>MH, SC, CL
<u>Highly Erodible</u> Silts & sands with moderate binder</th><th>SW, SP, GM, GC
<u>Moderately Erodible</u>
Gravels + fines & sands with little or no fines</th><th>GW, GP
<u>Slightly Erodible</u>
Gravels with little or no fines</th></tr>
<tr><td>1-3</td><td>200</td><td>300</td><td>400</td><td>500</td></tr>
<tr><td>4-6</td><td>125</td><td>200</td><td>300</td><td>400</td></tr>
<tr><td>7-9</td><td>100</td><td>150</td><td>200</td><td>250</td></tr>
<tr><td>10-12</td><td>70</td><td>100</td><td>150</td><td>200</td></tr>
<tr><td>13-25</td><td>50</td><td>50</td><td>75</td><td>100</td></tr>
<tr><td>25+</td><td>30-50</td><td>30-50</td><td>60-75</td><td>80-100</td></tr>
</table>
[1] American Society for Testing Materials, standard classification of soil for engineering purposes.

B. Space cross drains and rolling dips as appropriate on temporary roads according to road grade and soil type as described in FSH 2509.25 table 13.3 – Exhibit 01, Maximum Cross-Drain Spacing in Feet Based on Soil Types.</td><td>USDA Forest Service 2006, ASTM D-2487, and treatment-specific design</td></tr>
</table>

WQSP-8A	A. Site-prepare, drain, decompact, revegetate, and close landings, main skid trails, and temporary and intermittent use roads and other disturbed sites within one year after use ends. Provide stable drainage that disperses runoff into filter strips and maintains stable fills. Do this work concurrently. Stockpile topsoil where practicable to be used in site restoration. Revegetate using certified local native plants as practicable; avoid persistent or invasive exotic plants. B. Remove all temporary stream crossings (including all fill material in the active channel), restore the channel geometry, and revegetate the channel banks using certified local native plants as practicable; avoid persistent or invasive exotic plants. C. Restore cuts and fills to the original slope contours where practicable and as opportunities arise to re-establish subsurface pathways. Use certified local native plants as practicable; avoid persistent or invasive exotic plants. Obtain stormwater (402) discharge permits as required.	USDA Forest Service 2006 and treatment-specific design
WQSP-8B	In decomissioning roads, A. Implement suitable measures to close and physically block the road entrance so that unauthorized motorized vehicles cannot access the road. B. Establish effective ground cover (i.e. erosion control measures and revegetation) on disturbed sites to avoid or minimize accelerated erosion and soil loss. C. Evaluate risks to soil, water quality, and riparian resources and use the most practicable, costeffective treatments to achieve long-term desired conditions and water quality management goals and objectives. D. Use applicable practices of BMP Fac-2 (Facility Construction and Stormwater Control) for stormwater management and erosion control when obliterating designed roads. E. Implement suitable measures to re-establish stable slope contours and surface and subsurface hydrologic pathways where necessary to the extent practicable to avoid or minimize adverse effects to soil, water quality, and riparian resources. F. Remove drainage structures. G. Recontour and stabilize cut slopes and fill material. H. Reshape the channel and streambanks at crossing sites to pass expected flows without scouring or ponding, minimize potential for undercutting or slumping of streambanks, and maintain continuation of channel dimensions and longitudinal profile through the crossing site. I. Restore or replace streambed materials to a particle size distribution suitable for the site. J. Restore floodplain function. K. Implement suitable measures to promote infiltration of runoff and intercepted flow and desired vegetation growth on the road prism and other compacted areas. L. Use suitable measures in compliance with local direction to prevent and control invasive species. Design features described in Part 3, National Core BMPs, of the National Best Management Practices for Water Quality Management on National Forest System Lands shall be used as needed.	USDA Forest Service 2012

WQSP-9A	A. Restrict roads, landings, skid trails, concentrated-use sites, and similar soil disturbances to designated sites. B. Operate heavy equipment for land treatments only when soil moisture is below the plastic limit, or protected by at least 1 foot of packed snow or 6 inches of frozen soil. C. Conduct prescribed fires to minimize the residence time on the soil while meeting the burn objectives. This is usually done when the soil and duff are moist.	USDA Forest Service 2006, FSH 2509.18, Soil Management Handbook, 1992, and treatment-specific design
WQSP-9B	Fire lines and fuel breaks should utilize existing roads, skid trails, natural features, and use of wet lines as much as possible to minimize impacts caused by new line construction.	*Treatment-specific design*
WQSP-9C	The total length and width of constructed lines should be minimized. Blading to expose bare mineral soil displaces the nutrient and organic matter enriched surface horizon and increases the risk of erosion and spread of noxious weeds.	*Treatment-specific design*
WQSP-9D	Avoid dozer line construction on slopes greater than 30%.	*Treatment-specific design*
WQSP-9E	After use, pull soil and litter back into the fire line, seed, and top scatter slash if available. Where fire lines create cut slopes re-contour by pulling side cast or fill material back, seed, and top scatter slash if available immediately after use.	*Treatment-specific design*
WQSP-9F	Avoid direct ignition of concentrated areas of dry masticated materials greater than 2" in depth. Prescribed fire may be allowed to burn into these areas.	*Treatment-specific design*
WQSP-10	To ensure the HUC12 disturbance is less than 25 percent, maintain disturbance acres from mechanical harvest and roads to less than 25 percent of the HUC14 area.	Eaglin and Hubert 1993; USDA Forest Service 2006; and treatment-specific design

Wildlife, Fish and Rare Plants

Objectives:

1. Design treatments to meet applicable objectives and standards with the Southeren Rockies Lynx Amendment (SRLA). Consider guidelines outlined in the SRLA in treatment planning. When guidelines cannot be met, provide rationale to Fish and Wildlife Service (FWS) in year-end reporting.
2. Design treatments to meet applicable Forest Plan standards and guidelines related to wildlife.
3. Complete annual reporting to FWS as required by the SRLA.

WFRP-1	All applicable management Objectives, Standards and Guidelines contained in the Southern Rockies Lynx Amendment will be applied during treatment planning, analysis and implementation.	Southern Rockies Lynx Amendment (SRLA)
WFRP-2	At a minimum, in spruce-fir forest types maintain 90 to 225 snags per 100 acres, 10 inches in diameter at breast height (dbh) or greater (where biologically feasible). In aspen forest types, maintain 120 – 180 snags per 100 acres, 8 inches dbh or greater (where biologically feasible). Snags would be maintained away from structures, roads and trails so that they do not create safety hazards to the public. Where possible, utilize natural sinuosity or drainages for linking groups. Protect standing wildlife trees from damage during site preparation and post-sale activities.	GMUG Forest Plan Standards and Guidelines
WFRP-3	Maintain 10-20 tons per acre of coarse woody debris within harvest units. Where possible in regeneration units, create piles of logs, stumps, or other woody debris to minimize the effects of larger openings.	GMUG Forest Plan Standards and Guidelines
WFRP-4	Maintain large diameter downed logs in various stages of decomposition within harvest units (50 linear feet/acre of 10 inches diameter or larger at the large end of lodgepole pine and aspen logs and/or 12 inches diameter or larger for Engelmann spruce, subalpine fir and Douglas fir logs).	GMUG Forest Plan Standards and Guidelines

WFRP-5	Maintain screening cover consisting of live trees, snags, and course woody debris (including jackstraw piles) for lynx and other wildlife on strategically located portions, of the landscape (where feasible) between cutting units, roads, and meadows. This screening cover should be comprised of tree retention strips a minimum of 200 feet wide unless topographic breaks occur between cutting units, roads or meadow openings. This will be especially important within the lynx linkage zones.	Treatment- specific design to support consistency with the SRLA
WFRP-6	Northern goshawk - No activities will be allowed within ½ mile of active nests from March 1 to August 31 or until fledging has occurred. The timing restriction buffer could be reduced to ¼ mile if topographic features and/or adequate screening cover are present that would protect the nest site from disturbance. No harvest activities will be allowed within a 30-acre buffer of nest sites. Outside of a 30-acre area around goshawk nest sites, timing restrictions are not needed for treatment layout, marking, and any other activities that are non-disturbing (i.e., activities not involving the use of heavy equipment or chainsaws). Timing restrictions will only apply to active nests, as confirmed by the GMUG National Forests' wildlife biologist.	Colorado Parks and Wildlife Raptor Buffer and Timing Restriction Recommendations; GMUG Forest Plan Standards and Guidelines
WFRP-7	On-going surveys for raptors would be conducted to determine locations of individuals or populations of these species and allow for the implementation of protection measures using the appropriate buffer or timing restriction.	Treatment- specific design; Migratory Bird Treaty Act
WFRP-8	Retain all live trees in salvage units, except for trees that need to be removed for operational/safety or silvicultural purposes. Operational/safety or silvicultural purposes include the need to remove live trees if necessary to access dead trees for salvage or to address safety concerns.	Treatment- Specific Design
WFRP-9	Skid trails and landings will be located to minimize impacts to advanced regeneration. Both landings and skid trails will be designated as part of sale design. Skid trails will be placed at least 100 feet apart, except where they need to tie in together at landings.	Treatment- Specific Design
WFRP-10	Areas supporting live advanced regeneration will be avoided during unit layout (also SV-6). Focus should be placed on areas with >35% Dense Horizontal Cover in blocks greater than 0.3 acres.	SRLA
WFRP-11	Landings, temporary roads and main skid trails will be evaluated after the completion of operations to determine if detrimental soil compaction has occurred. Based on review by a specialist, when detrimental compaction is found, subsoil ripping will be applied to reduce soil impacts. This would provide for a more suitable seedbed for future regeneration, thus preventing permanent impacts of skid trails that when left in a compacted state, often do not regenerate as well as adjacent un-compacted areas.	Treatment- Specific Design
WFRP - 12	Surveys for threatened, endangered, and sensitive (TES) species will occur prior to design of a treatment. However, since it may take several years to fully implement a treatment, some level of TES re-survey will occur on an annual basis. If TES species are confirmed present the appropriate standards for the Forest Plan.	Treatment- Specific Design
WFRP-13	Winter logging is encouraged to limit direct disturbance to the fewest number of wildlife species as possible. When possible, avoid treatment activities in areas where big game (elk, pronghorn and moose) are known to occur. When big-game winter range is bisected by proposed haul routes and there are concentrations of animals along these routes minimize stress to wintering animals to the extent practicable by: A. Re-routing along another acceptable route. B. Restrict haul times between 9 am and 4 pm. The district biologist will coordinate with Colorado Parks and Wildlife to asses big game use and identify areas where animals concentrate during winter, and assess if there is a need to implement conservation measures. This would be a coordinated effort with the GMUG, Colorado Parks and Wildlife, and the timber purchaser.	GMUG Forest Plan General Direction 04, 05c. and 05f. (page III-76 – II-77)
WFRP-14	Gunnison sage-grouse – Portions of haul routes may occur in occupied habitat in few areas. Where use of haul routes have the potential to impact Gunnison sage-grouse as determined by the effects analysis, timing restrictions should be applied that prohibit the use of haul routes that occur within 0.6 mi of active leks (breeding sites) from March 15 – May 15.	Gunnison Sage-Grouse Rangewide Conservation Plan

WFRP-15	Habitat connectivity within harvest units will be maintained through the use of variable retention regeneration harvest methods. Tree retention blocks will cross the width of a large salvage area, but may include natural gaps in vegetation within the blocks. Since the proposed action includes maintaining high quality habitat (>35% DHC) in areas 0.3 acres or larger, these areas could be used as building blocks to maintain connectivity in areas where extensive salvage is proposed. Early-successional tree species will be retained along with shrubs and other vegetation. The blocks would typically be about 150 to 300 feet in length, and as wide as large salvage areas (depending on site conditions [e.g., availability of contiguous effective habitat on both sides of the salvage area, availability of natural connections in the area, fire risk of the fuels condition of the vegetation block, and present condition of the lynx habitat]). The retention blocks would include early-successional stages, or stand initiation that develops after the insect outbreak (such as reinitiation of lodgepole pine, Engelmann spruce and subalpine fir).	Treatment- specific design; developed in coordination with U.S. Fish and Wildlife Service. Intended to support consistency with SRLA direction for lynx habitat connectivity. Interagency Lynx Biology Team. 2013
WFRP - 16	To maintain the amount and distribution of lynx foraging habitat over time, manage so that no more than 30% of the lynx habitat in an LAU is in an early stand initiation structural stage or has been silviculturally treated to remove horizontal cover (i.e., does not provide winter snowshoe hare habitat). Emphasize sustaining snowshoe hare habitat in an LAU. If more than 30% of the lynx habitat in an LAU is in early stand initiation structural stage or has been silviculturally treated to remove horizontal cover (e.g., clearcuts, seed tree harvest, pre-commercial thinning, or understory removal), no further increase as a result of vegetation management treatments should occur on federal lands. Acres affected by lynx analysis unit through 2015 are available in the treatment analysis file. Cumulative impacts include all roads (assessed at 100% impact to the understory) and past management activity affecting the understory (harvest, prescribed fire, thinning, etc.) going back 25 years. It is assumed a 25% residual impact to the understory due to past vegetation management activities. As management occur in the affected LAU over the life of the treatment, acres affected will be tracked to ensure consistency with this conservation measure.	Interagency Lynx Biology Team. 2013

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APPENDIX C – PRE-TREATMENT CHECKLIST

Spruce Beetle Epidemic and Aspen Decline Management Response

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Project Name: _____

Project Location: _____

District:_____

Planning Steps

1. IDENTIFICATION OF PRIORITY WATERSHEDS

Instructions: To maximize the effectiveness of treatments to address public safety concerns and complete resiliency and recovery in an environmentally sensitive manner, priority watersheds would be determined. In most cases, watersheds ranging from 10,000 to 40,000 acres in size would be prioritized. The following guidelines would be used to determine priority watersheds for treatment:

- Public safety – removal of hazard trees adjacent to roads and other infra-structure. The primary objective of WUI treatments is creation of defensible space affording use of fire-fighters when needed. Treatments to increase public safety would be the highest priority when personnel and funding are limited.
- Ecology – based upon best available information, where have spruce and aspen ecology changed most over time due to human and natural disturbances? Where have these changes affected the range of conditions expected and the ability to achieve management objectives? The GMUG completed 5 geographic assessments (Grand Mesa, North Fork, Gunnison Basin, San Juan and Uncompahgre Plateau) that describe current and reference condition for spruce-fir and aspen ecosystems. These documents will be utilized where applicable.
- Time since mortality - Engelmann spruce typically die within a year of beetle infestation. Once dead, trees remain merchantable for about 3-5 years. Furthermore, the fire risk changes over time since mortality. Highest priority recovery (salvage) would be those experiencing recent mortality.
- Climate change projections – Aspen and spruce habitats have been classified into Lost, Threatened, Persistent, and Emergent categories, based on changes anticipated by the 2060 (See chapter 1). Generally, "Lost" habitat would be avoided for treatments oriented principally toward future resilience, unless short-term objectives are identified. Resilience treatments would be focused on Threatened habitat, and restoration treatments on both Threatened and Persistent habitats. At the appropriate time, managers may consider treatments designed to facilitate or assist migration into Emergent zones.
- Existing transportation system – areas having an existing transportation system adequate to facilitate removal and hauling of logs would be a priority for commercial harvest. Construction of new roads is costly and results in increased environmental impacts.

- Economic viability of treatments – Takes into account haul distances, layout costs, miles and type of roads needing to be constructed, and timber volume per acre.
- Site productivity – areas with the best tree growth. These sites have the highest tree volume per acre and the greatest potential for regeneration and/or tree planting success.
- Achievement of multiple resource management objectives – watersheds where resource management objectives for wildlife, watershed, fire and timber can be achieved.
- Wildlife – areas important to various wildlife species (elk calving areas, security areas, etc.) would be identified for avoidance and/or application of special management considerations. Typically special management considerations would be in the form of design features.

2. IDENTIFICATION OF PROPOSED TREATMENT AREAS

Instructions: After prioritizing watersheds for treatment, identify individual treatment units of spruce and aspen stands within the targeted watershed. Factors to be considered include: stand age and condition, level of mortality, opportunities for recovery and resiliency treatments, departure from desired conditions, availability of a road system, avoidance areas (riparian and wetland habitats, important wildlife areas where treatment may be detrimental, etc.) Forest Service corporate databases, on-the-ground knowledge of district employees and potentially outside sources such as Colorado Parks and Wildlife will be used as appropriate. Proposed treatment areas will be modified or additional areas added once surveys have been completed.

For commercial treatments, as stated in 36 CFR 219.14(c), lands identified as "suited" for timber production (and therefore, commercial opportunity areas as defined in SBEADMR), will be further evaluated to determine which lands are "not appropriate" for timber harvest. During treatment reconnaissance and layout, Forest Service personnel make a final determination of suitability based upon the following factors, and other considerations for resource protection:

- low productivity sites
- steep slopes (not to exceed 40%)
- sites where irreversible damage could occur
- visually sensitive areas

3. ID TEAM REVIEW

ID Team reviews preliminary treatment units and completes project-specific surveys. Conflicts will be resolved by the District Ranger.

Instructions: This section identifies surveys or on-the-ground reviews required by law, regulation or policy, as well as some which are optional which the Treatment ID team may elect to implement for each individual treatment. Those which are mandatory are noted as such. These data will be used to develop project-specific treatments areas, areas that should be avoided (e.g. cultural sites, sensitive wildlife areas, etc.) and helps establish project specific objectives and desired outcomes. Information derived from the surveys may also precipitate monitoring questions that should be considered by the ID Team. Examples for some program areas are provided.

Some specialties below have specific instructions which must be followed in order to maintain a level of effects which is documented in the accompanying EIS. These instructions are noted as mandatory as well.

☒Cultural Surveys

☐Obtain archeological surveys, clearances and potential sites to be re-evaluated.

☐ Identify cultural sites to be avoided on the ground

- Cutting/burning units
- Roads and landings

Instructions:

Cultural resource surveys will occur prior to project implementation. All eligible or unevaluated cultural resource sites within a treatment area will be avoided until State Historic Preservation Office consultation may be completed.

For all cultural resource sites located during the field inventory or previously known, no mechanical treatment or ground disturbing activities will occur within the site boundary, including an additional 50 foot buffer around the site. If mechanical treatments are necessary, the site and the 50 foot buffer around the site will be treated by hand to remove hazard trees and accumulated fuel build up.

If road construction cannot physically be relocated to avoid a site, and there is the potential for unidentified buried cultural remains, then SHPO consultation will take place and construction activities in the site boundaries would be monitored by an archaeologist.

Native American human remains: Any operator carrying out projects must notify the Forest Service, by telephone, with written confirmation, immediately upon the discovery of human remains or funerary items, discovered on federal land. The Forest Service must then immediately notify appropriate tribes of the find. All project activities must stop in the vicinity of the discovery that could adversely affect it, until tribal consultation can be completed and a Plan of Action can be approved and implemented.

District Archeologist Signature _____

☐Fire/Fuel Surveys

☐ Browns transects/photo points

☐ Silvicultural prescription

☐ Other surveys (specify)

☐ Determine minimum and maximum fuel loading associated with harvests and treatments.

Instructions:

Fire/Fuels Specialist Signature _____

☐Land Survey

☐ Forest Land Survey contact and survey has been completed.

Instructions:

Prior to commencing any ground- or vegetation-disturbing activities, evidence of the PLSS (Public Land Survey System) will be marked for protection. The Forest Land Surveyor shall be consulted to assist with providing data, searching for and evaluating evidence, and locating and protecting monuments of the PLSS from destruction.

Forest Land Surveyor Signature _____

☐Range and Invasive Species Surveys

☐ Pre-treatment invasive plant species surveys within and adjacent to treatment areas and access roads. Inventories will occur during the proper time of year for detection, and will occur in sufficient timing to conduct necessary pre-implementation treatments.

☐ Identify and map range improvements that could be affected by treatment activities.

☐ Range transects and witness trees and posts will be identified prior to treatments.

Instructions:

Based on survey of invasive weeds in the treatment area, prioritize weed infestations for treatment in high-risk sites, including project operating areas and along access routes. Control weeds as necessary prior to treatment implementation.

Identify the applicable design features from Appendix B. Care should be taken to apply those design features necessary to keep increases of invasive weeds resulting from treatment activities within the bounds described in the FEIS. Modify project as needed to reduce expansion of invasive weeds.

Include identified range improvements, range transects and witness trees and posts in the timber contract, service contract, or burn plan as features to be protected from disturbance during treatment activities.

Range Management Specialist Signature _____

☐Recreation

Ski Areas

1. Consult with ski area permit administrator, ski area, ski area snow-consultants about treatment plans and designs.

Developed Recreation Sites

1. Consult with District Ranger to identify priority developed recreation sites for treatment and other any other developed sites affected by treatment activities.
2. Consult with District Ranger to determine if sites are managed by Forest Service or under permit with a concessionaire.

Dispersed Recreation Sites

1. Consult with District Ranger to identify dispersed recreation sites that need to be treated or those that need to have a higher degree of clean-up than other general forest areas.

Trails

1. Consult with District Ranger to identify the location of any National Forest System Trail (NFST) to be impacted by treatment activities.
2. Additionally, identify designated National Scenic, Historic or Recreation Trails.
3. Identify managed snow trails.
4. Identify the types of uses and predominance along all trails.

Recreation Special Uses

1. Consult with District Ranger to identify the location of any authorized recreation special uses that would be impacted by treatment activities. Identify the types of uses that would be affected.

Scenic Byways

1. Consult with District Ranger to identify the location of Forest, State or National Scenic Byways.

Recreation Specialist Signature _____

☐Sensitive Plant Surveys

☐ Disturbances including road construction, reconstruction, landings, skid trails, and staging areas in potential habitat for sensitive species will be surveyed by a qualified botanist in the proper season prior to implementation. Surveys to be completed prior to treatment design and associated marking on the ground.

☐ Sensitive plant occurrences will be flagged and avoided for all ground- disturbing activities with a buffer of 20 – 100 feet.

☐ (See Soil and Water Surveys for delineation of Water Influence Zone (WIZ)).

Botanist/Ecologist Signature _____

☐Soil and Water Surveys

☐ Mechanical treatments from previous 25 years quantified and disturbance from all (proposed and previous) treatments and roads at HUC12 scale maintained at less than 25 percent of HUC12.

☐ All water influence zones (WIZ) delineated, flagged, and avoided.

☐ Unstable or landslide potential areas delineated, flagged, and avoided.

☐ Sensitive soil types, i.e. severe erosion hazard rating, slopes greater than 40 percent, and shallow soil depth mapped and potential impacts identified.

☐ Detrimental soil disturbance surveys completed.

☐ Proposed road locations evaluated for number and locations of stream crossings, length within WIZs, and the potential for impacts to the hydrology of groundwater dependent ecosystems

Instructions:

Select appropriate design features and BMPs (next step) to avoid impacts to WIZs and to minimize erosion and compaction potential from treatments and roads.

If necessary, modify treatment areas and roads as needed to avoid WIZs. Avoid practices that could impact the hydrology of groundwater dependent ecosystems.

For cumulative effects tracking, evaluate level of existing disturbance, reasonably foreseeable project disturbance, plus proposed treatment disturbance to determine potential for impacts to WIZs, and soil erosion, compaction, and productivity.

Identify total road density in the HUC12 watershed.

Modify treatment as needed to avoid increasing impairment of watershed conditions. Calculate proposed acres of disturbance due to mechanical harvest and roads at the HUC12 level. Maintain disturbance acres from mechanical harvest and roads at less than 25 percent of HUC12 area.

Create map products of WIZ buffers and sensitive soils (if needed) for use in the timber sale contract package.

Soil & Water Specialist Signature _____

☐Timber Surveys

☐ Stand Exams

☐ Insect and Disease Surveys

☐ Operational Feasibility and Access

☐ Silvicultural prescription and marking guides

☐ Other surveys/information (specify)

Instructions:

Use the results of the stand exams and insect and disease surveys to determine the existing conditions of the stands and the feasibility of mechanical vegetation treatment. Compare the existing conditions to the desired condition found in the prescription matrix (Appendix A) and determine the departure from desired condition to develop a range of treatment options. Present the range of treatment options to the interdisciplinary team to develop a treatment alternative that

will have a positive trend towards integrated resource indicators. Incorporate applicable silviculture design features (Appendix B).

TMA Signature _____

☐Transportation Planning Surveys

- ☐ Existing road to be used in the sale – Road log
- ☐ New specified road construction – flag-line with survey
- ☐ Final Road Design
- ☐ Other surveys (specify)

Instructions:

Evaluate and select the applicable design features for transportation systems and haul routes, in order to keep effects to existing routes and effects from new routes within the bounds disclosed within the FEIS that supports the Record of Decision for this project.

If treatment requires use of roads beyond Forest Service jurisdiction, approval and authorization is completed via additional NEPA.

Engineering Signature _____

☐Visual Resources Surveys

- ☐ Identify valued scenic resources
- ☐ Identify sensitivity level of scenery
- ☐ Identify treatment area's visual quality objectives, per Forest Plan guidance

Instructions:

Evaluate and select the applicable design features for visual resources such that the treatment area's identified visual quality objectives are achieved consistent with the Forest Plan.

Recreation Specialist Signature _____

☐Wildlife and Fish Surveys

☐ Coordinate with CPW to identify areas important to various wildlife species (elk calving areas, security areas, etc.) for avoidance and/or application of special management considerations. Typically special management considerations would be in the form of design features.

☐ Northern goshawk/forest raptor surveys

☐ Conduct old growth inventories if high percentage of treatment area is live

☐ Dense horizontal cover surveys (Canada lynx)

☐ Field verification of GIS mapped lynx habitat

☐ Snow tracking surveys primarily for timber sale areas

☐ Neo-tropical migratory bird monitoring – point count surveys consistent with the Rocky Mountain Bird Observatory (primarily in areas on the Forest where RMBO data is lacking information on species densities and population trends at the Forest-scale, such as Brewer's sparrow and red-naped sapsucker; otherwise we just use their existing data and do not conduct new surveys)

☐ Document nest sites for MIS and Sensitive primary and secondary cavity nesters, such as red-naped sapsucker, boreal owl, and flammulated owl.

☐ Confirm presence of American marten in project areas using bait stations with soot track plates and remote cameras

☐ Gunnison sage-grouse presence/absence surveys (look for pellets, direct observations); collect vegetation data to determine habitat suitability for sage-grouse based on Range wide Conservation Plan habitat guidelines.

☐ Conduct photo-point monitoring of prescribed burn areas by establishing pre-treatment photo points, and repeating the photos post-treatment.

☐ Abert's squirrel surveys for prescribed burn projects in ponderosa pine forests

☐ Other species (specify)

Instructions:

Complete surveys required by policy, regulation or law. While completing ground reconnaissance, look for opportunities to achieve multiple resource management objectives. Examples could include but are not limited to removal of spruce or fir.

District Biologist Signature _____

4. FINALIZE DETAILED TREATMENT PLAN

All of the following design features and requirements will be followed in the implementation of this project.

Cultural ☐

Applicable Design Features (list):

A.
B.
C.

District Archeologist signature _____

Fire/Fuels ☐

Design features are required to be implemented as necessary in order to maintain fuel levels from treatments within the bounds described in the FEIS; SP-2 and SP-6 apply to all treatments and are included below.

Select additional appropriate design features and BMPs to limit the effects or levels of activity-generated fuels to those disclosed in the FEIS that accompanies the record of decision. See Appendix B.

A. SP-2: A minimum and maximum fuel loading will be specified in association with harvests and fuels treatments. This minimum and maximum will include any needs to reduce fuels near infrastructure and leave material onsite for seedling establishment, wildlife benefit and soils health. Generate associated Brush and Disposal (BD) plan.
B. SP-6: Reduce activity-generated fuels in compliance with the treatment Brush and Disposal (BD) plan. Fuels, silviculture and timber resources management personnel would develop prescriptions considering economical harvest methods, activity fuels and residual site conditions.

C.

Fire Specialist signature _____

Range and Invasive Plant Species ☐

Applicable Design Features (list):

A.
B.
C.

Range Management Specialist Signature _____

Soil and Water ☐

Applicable Design Features (list):

A.
B.
C.

Soil and Water Specialist signature _____

Threatened, Endangered and Sensitive Species ☐

Applicable Design Features (list):

A.
B.
C.

District Biologist signature _____

Transportation ☐

Applicable Design Features (list):

A.
B.
C.

Engineer signature _____

Treatment Units and Silvicultural Prescriptions Complete ☐

Applicable Design Features (list):

A.
B.
C.

TMA Signature _____

Visual Quality & Scenic Resources ☐

Applicable Design Features (list):

A.
B.
C.

District Recreation Planner signature _____

5. IDENTIFICATION OF TREATMENT- SPECIFIC MONITORING

(e.g. biologist found a goshawk nest that will require validation of use prior to logging)

Cultural_____

Specified monitoring:

A. ☐ For treatments where field inventories are not feasible due to visibility concerns prior to treatment implementation, monitoring in the form of a sample inventory for cultural resources will be required post implementation. This monitoring will take place within one year of treatment implementation, with results provided to SHPO (Per 2013 Prescribed Fire Programmatic Agreement w/SHPO).
B. ☐ Cultural resource sites that were required to be avoided during treatment implementation will be monitored for effectiveness of the protection measures following treatment completion (Per 2013 Prescribed Fire Programmatic Agreement w/SHPO).

Range & Invasive Species_____

Specified monitoring:

A. ☐ Post-treatment invasive plant species surveys:

Inspect and document all limited term ground-disturbing operations in infested areas for at least three (3) growing seasons following completion of the project.

For on-going projects, continue to monitor until reasonable certainty is obtained that no new infestations have occurred. Provide for follow-up treatments based on inspection results (USDA Forest Service 2001).

Transportation

Specified monitoring:

A.
B.
C.

Wildlife

Specified monitoring:

A. Survey dense horizontal cover in accordance with the Southern Rockies Lynx Amendment.
B.
C.

Silviculture

Specified monitoring:

A. Complete stocking surveys in order to certify the area. Includes species composition and age class.
B.
C.

6. FOREST PLAN CONSISTENCY

Preliminary treatment units reviewed by ID Team for Forest Plan Standards and Guideline compliance. Some conformance components many not be applicable to a given project, given resources present or absent, differing plan objectives across the planning area, etc. The justification notes how the project meets the identified plan component via existing resource conditions, survey findings, assigned project design features, etc.

☐Recreation, Trails, & Wilderness

Project design is consistent with:

☐ or N/A Visual quality objectives (VQO).
Justification:

☐ or N/A Retention of ROS recreation settings.
Justification:

☐ or N/A Protection of cultural resources.
Justification:

☐ or N/A Standards and guidelines (S&G's) for motorized trail density in Rx 2A.
Justification:

☐ or N/A S&G's for wilderness use effect on wilderness setting.
Justification:

Recreation Staff Signature _____

☐Riparian

Project design is consistent with:

☐ or N/A S&G's for managing riparian habitat in the 9A Rx
Justification:

☐ or N/A Design and implement management activities which sustains inherent visual values of riparian areas.
Justification:

☐ or N/A Manage forest cover types to perpetuate tree cover and provide healthy stands.
Justification:

☐ or N/A Locate roads and trails outside riparian areas unless alternative routes

Have been reviewed and rejected as being more environmentally damaging.
Justification:

☐ or N/A Minimize detrimental disturbance to the riparian area by construction activities. .
Justification:

Range Staff Signature _____

Wildlife Staff Signature _____

Fisheries Staff Signature _____

☐ Range

Project design is consistent with:

☐ or N/A S&G's for forage utilization standards.
Justification:

☐ or N/A Desired habitat condition (seral stage) and/or direction of trend.
Justification:

☐ or N/A The prevention of noxious weeds infestation.
Justification:

Range Staff Signature _____

☐Soil, Water, and Air

Project design is consistent with:

☐ or N/A S&G's where there is potential to impact soil and water resources.
Justification:

Watershed Staff Signature _____

☐Timber

Project design is consistent with:

☐ or N/A Regeneration survival and stocking standards.

Justification:

Timber Staff Signature _____

☐Transportation and Facilities

Project design is consistent with:
☐ or N/A S&G's for the rehabilitation of temporary roads.
Justification:

☐ or N/A S&G's for non-use of obliterated roads.
Justification:

Engineering Staff Signature _____

☐Wildlife, Fish and Rare Plants (Forest Plan Direction pages III-24 to III-34)

Project design is consistent with:
☐ or N/A The habitat requirements for snags, course woody debris, seral stages, edge index, & spatial habitat.
Justification:

☐ or N/A The desired habitats for MIS and other desired species.

Justification:

☐ or N/A The minimum habitat needs for vertebrate wildlife species.
Justification:

☐ or N/A Maintaining integrity and proper levels of biological old growth vegetation and spatial requirements to meet habitat requirements of dependent species. At the watershed scale maintain at least 5 to 12% of the cover type in old growth.
Justification:

☐ or N/A Habitat conditions that provide the most effective use by big game.
Justification:

☐ or N/A ☐ or N/A Section 7A1 of Endangered Species Act for T&E plant and animal species.

Justification:

☐ or N/A S&G's for fuel treatments and vegetation in lynx and game species habitat.
Justification:

☐ or N/A SRLA Standard VEG S1 – No more than 30% of the lynx habitat in the LAU can be in stand initiation structural stage.
Justification:

☐ or N/A SRLA Standard VEG S2 – Timber management projects cannot regenerate more than 15% of lynx habitat in a LAU in a 10-year period.
Justification:

☐ or N/A SRLA Standard VEG S5 – Pre-commercial thinning practices and similar activities intended to reduce seedling sapling densities will be limited to with 200 feet of administrative sites, buildings or outbuilding s or for conifer removal within aspen when aspen is declining.
Justification:

☐ or N/A SRLA Standard VEG S6 – Multi-story spruce-fir stands. Pre-commercial thinning practices and similar activities intended to reduce seedling sapling densities will be limited to within 200 feet of administrative sites, buildings or outbuildings, for incidental removal of understory during salvage logging, and for conifer removal within aspen when aspen is declining. Uneven-aged management should be employed to maintain and encourage multi-story stand structure.
Justification:

☐ or N/A SRLA Guidelines VEG G1, G4, G5, G10:
Justification:

☐Fisheries

Project design is consistent with:

☐ or N/A Habitat needs for trout and macro-invertebrate species?
Justification:

☐ or N/A Fisheries S&G's.

Justification:

Fisheries Staff Signature _____

☐**Socio-economics**

☐ or N/A Project design addresses effects on local economies of Forest outputs.
Justification:

NEPA Staff Signature _____

7. CONTRACT REVIEW

TMA and Contracting Officer complete a review of the contract package to ensure specified design criteria are identified within various contract C provisions.

Signature _____
Contracting Officer Date

8. DISTRICT RANGER APPROVAL

Signature _____
District Ranger Date

APPENDIX D. ANNUAL INTERDISCIPLINARY TEAM TREATMENT REVIEW

Spruce Beetle Epidemic and Aspen Decline Management Response

Objectives of the Treatment Review

The treatment review is a monitoring method that provides documentation that treatments are implemented as planned. The treatment review, combined with monitoring results and research findings, is intended to provide feedback to forest managers about how to best design and implement future treatments in the treatment area. The results of this monitoring, in conjunction with best available science, will identify relevant improvements to procedures or exemplary practices to benefit future treatments authorized by the SBEADMR record of decision (See Figure 1).

Focus of the Treatment Review

Implementation of the treatments described in the silvicultural prescription matrix (Appendix A) will be conducted in conjunction with the use of the design features described in the EIS (Appendix B) and identified in the Treatment Design Checklist (Appendix C). This will ensure that treatments are designed and implemented according to the assumptions described and disclosed in the EIS.

Prior to treatment review, the GMUG will monitor the use of Best Management Practices (BMPs) for Water Quality Management on National Forest System Lands[30]. The monitoring procedures, personnel, timing, and tracking are explained in the Best Management Practices Protocols and Evaluation forms[31]. The focus of this monitoring is documentation of the use of soil and water BMPs on a treatment.

Treatment reviews will also document that additional appropriate design features were selected and implemented in accordance with Forest Service standards or design specifications. They will also document if the design features were, in a readily observable way, effective. These reviews,

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[30] National Best management Practices for Water Quality Management on National Forest System Lands http://www.fs.fed.us/biology/resources/pubs/watershed/FS_National_Core_BMPs_April2012.pdf

[31] BMP Monitoring Protocols and Forms http://fsweb.wo.fs.fed.us/wfw/watershed/national_bmps/bmp_docs-vegetation.html

completed by interdisciplinary teams of resource specialists, will be completed when the BMP evaluations are completed.

Findings from the treatment reviews can also be a mechanism to complete year-end reporting to regulatory agencies. For example, one of the design features for Canada lynx is to protect high quality habitat (greater than 35% dense horizontal cover) in the form of live advanced regeneration in blocks of 0.3 acres or larger. Treatment reviews will determine if this feature was followed and, in a readily observable way, was it effective. The validation of adherence with standards and guidelines in the Southern Rockies Lynx Amendment, EIS analysis assumptions, and other information pertinent to effects of activities on listed or proposed species will be reported to the US Fish and Wildlife Service on an annual basis.

Avoidance and protection of archeological resources is another reporting requirement. If a treatment review indicates a particular treatment did not follow a design feature, the report to the regulatory agency will include "corrective actions" to bring the Forest Service back into compliance. Most of the time, this will be an administrative fix (for example, working with the sale administrator to ensure archeological resources are flagged before ground disturbing activities occur). Findings will be reported to the State Historic Preservation Office as required by the GMUG Programmatic Agreement[32].

Results from treatment reviews will be part of annual reporting to the Forest Leadership Team for the Management Review. The Management Review could result in changes to design features to make them more effective or additional features could be added if needed. Management review could also identify additional monitoring measures that may be needed.

Management Reviews will also consider new best available science, changes in agency policy or direction, or changed conditions (such as the US Fish and Wildlife Service listing a species as threatened or endangered), and determine whether those changes warrant modified design features or modifications to treatment planning or implementation. The GMUG NF has partnered with the Rocky Mountain Research Station (RMRS) whose role is to keep the Forest abreast to changes in the science related to spruce and aspen ecology and management. The RMRS will also complete administrative studies as needed to address monitoring questions beyond the scope of those normally addressed by Forest Service managers (GMUG Informal Agreement, 2015).

In some cases, changed conditions may bring into question whether the scope and range of effects disclosed in this analysis are exceeded. Typically, a change in a design feature making it more

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[32] Programmatic agreement between the Colorado State Historic Preservation Office and the Forest Service. A Section 106 (National Historic Preservation Act, as Amended, [NHPA]) Notification will be initiated under the Colorado National Forests Bark Beetle Programmatic Agreement (PA)[32] for the SBEADMR Project in partial fulfillment of the requirements of the National Historic Preservation Act, as amended.

effective in protecting resource values or achievement of a desired outcome falls within the scope and range of effects. Elimination of a design feature intended to minimize effects would likely be outside range and scope of the analysis. A change in assumptions analyzed in the EIS could also trigger a NEPA sufficiency review. For example, it was assumed that the level of impact to habitat supporting Canada lynx would stay within Forest-level caps identified in the Southern Rockies Lynx Amendment (SRLA). These caps will be tracked over the life of the treatment, and if tracking indicates a pending exceedance in any given year, no additional treatment would be permitted until it is re-analyzed and additional consultation with Fish and Wildlife Service was completed. Substantive changes will require the Forest to undertake an interdisciplinary review of the sufficiency of the NEPA documentation prepared for this treatment. The review may show the information in the original decision is still valid, and is not in need of correction or supplement. However, if that review illustrates a need for a correction, supplement or revision to the original decision, then the specific process to correct, supplement, or revise the analysis would be used, as specified in FSH 1909.15(18.2).

If the Forest Leadership Team makes changes to design features, implementation checklists, or monitoring, whether through correction, supplement, or revision, those changes will be applied to all future treatments on the GMUG NF which are authorized by the record of decision for this analysis.

The figure below shows how treatment review fits into the implementation strategy.

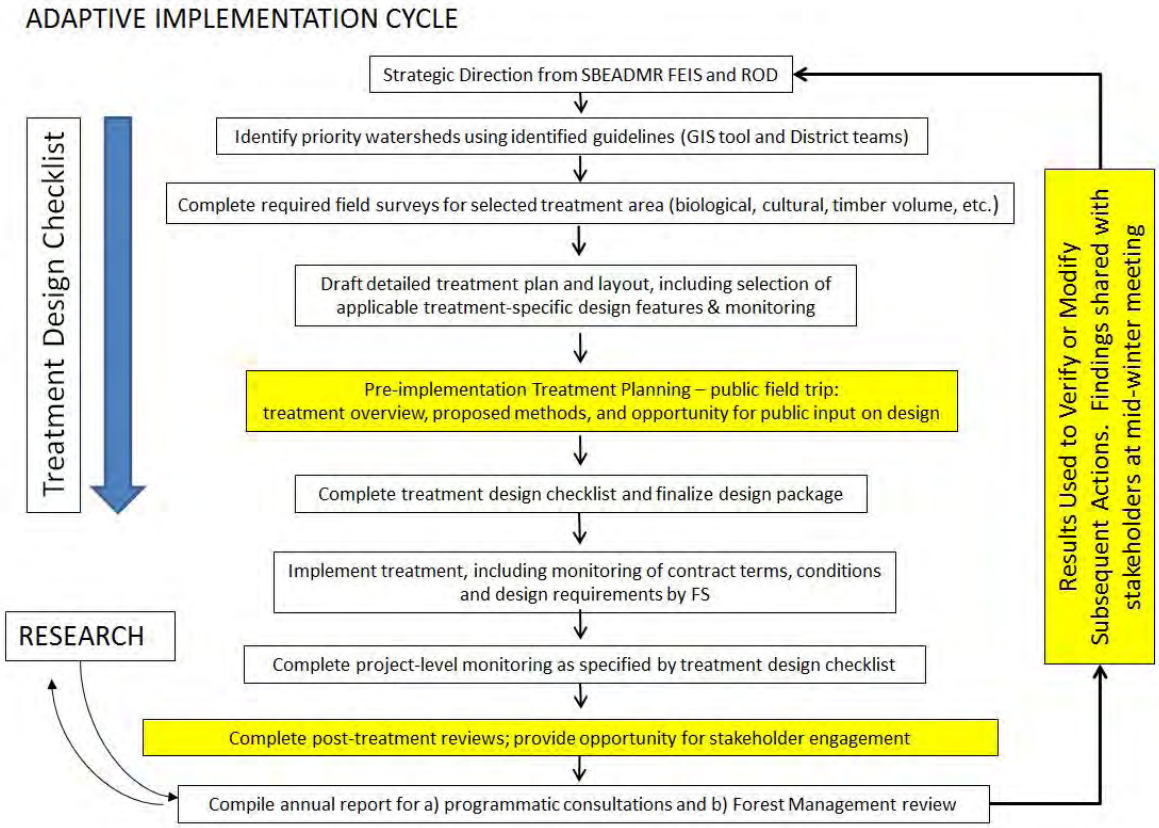

Figure 49. Adaptive implementation cycle.

Treatment Selection and Review Team

One treatment in each of the three zones on the GMUG, selected from the group of treatments implemented in a fiscal year, will be reviewed annually forest-wide by a review team.

At a minimum, the review team should include the District Ranger for the unit, the unit treatment lead, the treatment or sale administrator, and specialists from the treatment resource issue areas, e.g. silviculture, fuels, wildlife, aquatics, soils, hydrology, etc. The Forest SBEADMR coordinator should also participate in the review to ensure consistency throughout the life of the SBEADMR project.

The unit line officer will designate the review team leader.

Document Review

The treatment review process relies on existing Forest Service documents and records. As indicated in Table 1, the documents might vary depending on whether the treatment is a timber sale, stewardship contract, service contract, force account, burn plan, etc.

A document review is intended to be a fairly brief exercise (1/2 day per treatment). The document review will focus on the treatment implementation checklist and supporting documentation. Records completed by individuals overseeing treatment implementation (timber sale administrators, Force account supervisors, etc.) will also be reviewed. The team should review or be familiar with the treatment documents, but should rely upon the responsible or most knowledgeable team members to orient them to the treatment and documentation and explain 1) how design features were selected and 2) how design features were implemented on-the-ground.

The field review will focus on an identified subset of the applied design features. This subset may be chosen to maximize the learning opportunity and/or based on public interest. It will usually not be possible to review all prescribed design features in the field.

Things to consider when choosing design features to review and monitor in the field:

- Design features with readily observable evidence of their implementation
- Line officer concern
- Unconventional or experimental mitigations
- Design features specifically requested by the public or regulatory agencies
- Design features critical to environmental protection
- Design features that relate to SBEADMR project appeal points, if applicable
- Design features related to the issues identified in the EIS

Table 1 provides a list and description of the records that forests should consider during the document review of a treatment. During the document review, the review team will check the documents listed in Table 1 for evidence that treatment identification and implementation reflected SBEADMR guidance. These documents should already be part of the treatment record and should remain on file in the forest-level file system.

The attached Treatment Information Forms will be completed during the document review. A Design Feature Score Card will be completed for each design feature reviewed in the field, as well as each monitoring item identified in the Treatment Design Checklist. A Treatment Summary Scorecard will provide quantitative metrics of compliance and effectiveness of SBEADMR implementation, but is not a substitute for data and information obtained from monitoring and research. Treatment reviews will be used in conjunction with both, as discussed above, to feedback into continued implementation of the SBEADMR project.

Table 1. Documents and Records for Use in SBEADMR Treatment Review

Process Step	Relevant Records	Stage of Review
COMPLIANCE ***Monitoring conducted for general treatment design and implementation, all design features, and treatment-specific monitoring.***		
1. Treatment Implementation checklist completed (including surveys, documentation of Forest Plan compliance, detailed treatment plan, and identification of treatment-specific monitoring)	Treatment Design Checklist	Document Review
2. Were the design features identified in the implementation checklist incorporated in the treatment contract/force account instructions/burn plan objectives?	Treatment Design Checklist, Section 5	Document Review
	Silvicultural prescription (i.e., wildlife treatment, prescribed fire, etc)	
	Layout/marking instructions	
	Contracts: Timber sale contract or stewardship contract or service contract Force Account Treatments: Force account instructions	

Process Step	Relevant Records	Stage of Review
3. Were the design features implemented on the ground?	Timber contract: Sale administrator's timber sale inspection reports Service Contract: Contracting Officer Representative's (COR's) daily diaries and inspection reports Force Account: Treatment leader's daily diaries and inspection reports	Document Review
4. Was identified treatment-specific monitoring conducted? ***(Secondary question: What did monitoring reveal?)***	Treatment Design Checklist, Section 7 Records of monitoring data	Document Review
EFFECTIVENESS ***Monitoring conducted for a subset of design features and for the use of BMPs for Water Quality Management.***		
1. Were the appropriate features applied given presence/absence of the resource concern?	Treatment Design Checklist, Section 5	Field Review
2. Were the design features, as readily observed, *effective*? If not, why not?		Field Review
3. Monitor use of the BMPs for Water Quality Management on NFS Lands		Field Review
4. Are there recommended changes in design features of soil and water BMP's to make them more effective or implementable?		Field Review

Field Review

Based on the document review, the team will select which design features to further review in the field, along with the associated activity units, roads, landings, or other components of the treatment.

The Interdisciplinary Team should be plan a full day in the field for each treatment to allow for interdisciplinary discussion. In some cases, individual ID Team members may spend 1 to 2 days prior to the formal Team review to acquaint themselves with the treatment. The emphasis is on documenting readily observable evidence of the implementation of the prescribed design features. Consideration should be given whether or not the design features were implemented in accordance with Forest Service specifications or practices and are effective in achieving the desired outcomes (e.g. water bars were constructed on a skid trail in accordance with contract specifications and are effective in draining water from the trail and thus preventing surface erosion). If warranted, recommendations to modify a design feature to make it more effective or implementable should also be provided.

The Design Feature Score Card will be completed during the field review.

Stakeholder Involvement

Once the Forest ID Team has completed their assessment of a treatment, the Line Officer upon whose District the treatment resides will invite interested publics to a day in the field to review the findings of the ID Team. Typically this will occur within 1 month of the formal ID Team review. Public review will include ID Team recommendations for corrective actions if needed. Public input related to the treatment design and outcomes will also be sought for summarization to Forest Leadership Team (FLT) during the annual Management Review. Changes agreed upon by FLT will be posted to the Forest website and will be applied to all subsequent treatments implemented under the SBEADMR Record of Decision.

Records Management

Completed Treatment Information Forms and Score Cards will be filed with the SBEADMR project leader at the Supervisor's Office. The project leader will also tally the scores for all the design features reviewed on Treatment Summary Score Card. Completed forms generated from the National Best Management Practices Review will be entered into the database of record and a summary provided to the SBEADMR treatment lead.

As noted above, the SBEADMR project leader will use these materials to prepare an annual report on SBEADMR implementation, in combination with additional treatment monitoring results and/or research findings.

In addition to the results of the ID Team treatment reviews, the following information will be summarized in a report to the Forest Leadership Team. This additional information is required by regulatory agencies such as State Historic Preservation Office and Fish and Wildlife Service.

- Evidence that cultural resource sites were protected in accordance with the GMUG PA.
- Evidence that applicable standards and guidelines in the SRLA were followed. If a guideline was not followed, provide rationale why the guideline could not be followed.
- Reporting requirements contained in the SBEADMR Biological Opinion.

A final report summarizing findings from the document and filed reviews, including any corrective actions taken by the FLT, will be posted on the Forest website annually. Any reporting required by the Programmatic agreement between the Colorado State Historic Preservation Office or Fish and Wildlife under the SRLA or SBEADMR Project BO will also be completed and submitted on an annual basis.

SBEADMR Treatment Information Form

District:_____

Treatment Name:_____

Total Acres Treated: _____ Legal Location:_____

Implementation Document Type: (Circle one) Timber Contract /Stewardship/Service Contract/Force Account)

Date Treatment Design Checklist was approved by the Line Officer: _____

Dates of Review: _____

Review Team

Enter the names and position titles of all the review team members.

Name	**Position/Specialty**
	Project Leader
	Line Officer or Designee
	Hydrologist/soil scientist
	Wildlife Biologist
	Archeologist
	Recreation Specialist
	Timber Management Assistant
	SPEADMR Team Leader

Treatment-level Review - Step 1

Forest Plan Conformance

Is adequate justification provided on the Project Design Checklist indicating adherence with Forest Plan direction? Did project review support this conclusion? Why or why not?

Overall Rating for Step 1[33] Justification documenting adherence to Forest Plan exists on the Project Design Checklist and was validated in the field. ” = _____

[33] 3 – Full evidence of Forest Plan Conformance.

2 – Partial evidence of Forest Plan Conformance.

1 – Insufficient evidence of Forest Plan Conformance.

TREATMENT-LEVEL REVIEW – STEP 2

Design Feature Implementation

Were design features applicable to the treatment identified on the treatment design checklist and incorporated into the mechanism used to implement the treatment (timber sale contract, burn plan, force account direction, etc)?

Is there evidence that design features were implemented as designed (evidence may include field verification or documented in administration records for the project)?

If not, was rationale provided why the design feature could not be implemented (e.g. sale administrator could not implement specified design features in Appendix B but coordinated with District Biologist to implement measures with an acceptable level of impact)?

Overall Rating for Step 2[34] "Were required design features identified and implemented?" = ____

[34] 3 - Full evidence that applicable design features were identified and implemented.
2 - Partial evidence that applicable design features were identified and implemented.

1 - Insufficient evidence that applicable design features were identified and implemented.

Instructions for Reviewing Design Features

Only design features selected for review need be recorded. See suggested criteria, under document review, above. Use a new form for each design feature reviewed. (See table below).

Row 1 – Describe the design feature and the year the work was completed on the ground.

Row 2 – Why was this design feature selected for review?

Row 3 and 4 Ratings – Provide the rating that represents the consensus of the review team for the question in each row. The rating score recognizes that this assessment is qualitative.

3 - Full evidence that design feature was implemented and, in a readily observable way, effective.
2 - Partial evidence that design feature was implemented and, in a readily observable way, effective.

1 - Insufficient evidence that design feature was implemented and/or it was ineffective to mitigate or eliminate an undesirable outcome.

Row 5 – If applicable to this design feature, is there evidence to support the assertion on the treatment design checklist of compliance with Forest Plan direction?

Row 6 – Record any additional observations. Use of photographs is encouraged. This could include any major problems noted with the design feature and/or any exemplary practices noted. For example, was there anything about how the design feature was planned or implemented that should be considered in future projects?

.

Instructions for Reviewing Required Monitoring

Only monitoring identified on the Treatment Design Checklist and selected for review need be recorded. Use a new form for each Monitoring item reviewed. (See table below).

Row 1 – Was the identified treatment-level monitoring completed? Specify which resource required the monitoring and the duration and methods specified.

Row 2 - Was the information used as intended by the resource requiring the monitoring?

Specify how the data was used.

Use the following ratings:

3 - Full evidence that monitoring was completed as specified on Project Design Checklist AND data utilized as specified by the resource specialist. .
2 - Partial evidence that monitoring was completed as specified on Project Design Checklist OR data partially utilized as specified by the resource specialist.

1 - Insufficient evidence monitoring was completed.

Design Feature Score Card

Project Name:			**Design Feature Reviewed: ___ of ___**
Row	**Operational Control Step**	**Evidence Observed**	**Rating**
1	**Describe design feature, including year work was completed.** *Identify Feature number from Appendix B of the EIS. If another standard Forest Service publication, give source.*		N/A
2	**Reason selected for review.**		N/A
3	**Was the design feature implemented on the ground as planned?** *Cite treatment activity units in which observations were made.*		
4	**If implemented, was the design feature - in a readily observable way, effective?**		

Project Name:			Design Feature Reviewed: ___ of ___
Row	**Operational Control Step**	**Evidence Observed**	**Rating**
5	**If applicable to this design feature, is there evidence to support assertion on the treatment design checklist of compliance with Forest Plan direction?**		N/A
6	**Other observations or comments:**		N/A

Monitoring Score-card

Project Name:			**Monitoring Item Reviewed: ___ of ___**
Row	**Operational Control Step**	**Evidence Observed**	**Rating**
1	**Was the identified treatment-level monitoring completed?** *Specify which resource required the monitoring and the duration and methods specified.*		
2	**Was the information used as intended by the resource requiring the monitoring?** *Specify how the data was used.*		
3	**Document outcomes of the monitoring if available for summarization in the Management Review.**		

Treatment Summary Score Card

District: _____

Treatment Name: _____

Scoring:

3 – Full Evidence

2 – Partial Evidence

1 – Insufficient Evidence

Treatment-Level Review	Step 1	Step 2
Plan Conformance		
Design Feature Implementation		

Design Feature Review	Resource	Design Feature Number[1]	Row 3	Row 4
Design Feature 1[2]				
Design Feature 2				
Design Feature 3				
Design Feature 4				
Design Feature 5				
Design Feature 6				
Design Feature 7				

Design Feature Review	Resource	Design Feature Number[1]	Row 3	Row 4
Design Feature 8				
Design Feature 9				
Design Feature 10				
Design Feature 11				
Design Feature 12				
Design Feature 13				
Design Feature 14				
Design Feature 15				

[1] Appendix B of the EIS provides a complete listing of design features and associated number. If additional standard Forest Service source was used, identify reference.

[2] Design feature # is keyed to the individual Design Feature Score Card

Monitoring Review	Resource	Row 2
Monitoring Item 1		
Monitoring Item 2		
Monitoring Item 3		

SAMPLE 1: SBEADMR TREATMENT INFORMATION FORM

District: Gunnison

Treatment Name: Example 1 Timber Sale

Total Acres Treated: 542 **Number of Treatment Units 7**

Implementation Document Type (Timber Contract/)

Dates of Review: June 18-19, 2016

Review Team

Enter the names and position titles of all the review team members.

Name	Position/Specialty
Drew Stroberg	Team Leader
John Murphy	Unit Line Officer
Clay Speas	SBEADMR Lead
Don Stump	Sale Administrator
Matt Vasquez	District Biologist
Ben Stratton	Zone Hydrologist
Justin Lawrence	Archeologist
Chad Wellman	Civil Engineer

SAMPLE 1: Design Feature Score Card

Treatment Name: Example 1 Timber Sale			**Design Feature Reviewed: _1__ of __2_**
Row	**Operational Control Step**	**Evidence Observed**	**Rating**
1	**Describe design feature, including year work was completed.** *Identify Feature number from Appendix B of the EIS. If another standard Forest Service publication, give source.*	W-XX: Maintain connectivity within Canada lynx linkage zones. 2016.	N/A
2	**Reason selected for review.**	The public has expressed concern that this forest plan standard is not being consistently implemented as intended. The Southern Rockies Lynx Amendment requires spot monitoring for compliance with standards and guidelines. Findings will be reported to FWS through annual the annual reporting requirement specified in the BO.	N/A

Treatment Name: Example 1 Timber Sale			Design Feature Reviewed: _1__ of __2_
Row	**Operational Control Step**	**Evidence Observed**	**Rating**
3	**Was the design feature implemented on the ground as planned?** *Cite treatment activity units in which observations were made.*	The district biologist worked with TMA to layout 500 foot-wide to ¼ mile "no harvest" areas within the Slumgullion lynx linkage zones. Areas left un-cut contained high quality hare habitat (>35% DHC) and were of sufficient width to allow movement of lynx through the landscape. Less than 10% of the linkage zone was affected by sale activity. Layout completed in summer 2014. Harvesting will occur in 2015.	3
4	**If implemented, was the design feature - in a readily observable way, effective?**	Un-cut areas were identified on the sale area map, marked on the ground and sale administrator worked with purchaser to avoid the areas. Some trees along the edge of the cutting units were subject to windfall. The few blow-down trees had little/no effect on the functionality of the strip to maintain connectivity for lynx movement.	3
5	**If applicable to this design feature, is there evidence to support assertion on the treatment design checklist of compliance with Forest Plan direction?**	Yes – Design and layout of leave strips accomplished two Forest Plan requirements: Maintain connectivity for lynx and protected areas of high quality (>35% DHC) hare habitat. This aspect of the project is in full compliance with Forest Plan direction and requirements of the SBEADMR BO.	N/A

Treatment Name: Example 1 Timber Sale			Design Feature Reviewed: _1__ of __2_
Row	**Operational Control Step**	**Evidence Observed**	**Rating**
6	**Other observations or comments:**	(Would attach photo).	N/A

Sample 1 - Monitoring Score Card

Project Name: Example 1 Timber Sale			Monitoring Item Reviewed: _1__ of _1__
Row	**Operational Control Step**	**Evidence Observed**	**Rating**
1	**Was the identified treatment-level monitoring completed?** *Specify which resource required the monitoring and the duration and methods specified.*	Yes. Post-treatment invasives monitoring	N/A
2	**Was the information used as intended by the resource requiring the monitoring?** *Specify how the data was used.*	Yes. With no evidence of nest use, logging was allowed to continue under normal operating provisions.	3

Project Name: Example 1 Timber Sale			Monitoring Item Reviewed: _1__ of _1__
Row	**Operational Control Step**	**Evidence Observed**	**Rating**
3	**Document outcomes of the monitoring if available for summarization in the Management Review.**	See above.	N/A

APPENDIX E: PUBLIC ENGAGEMENT IN ADAPTIVE IMPLEMENTATION

A Process for Adaptive Implementation of the Spruce Beetle Epidemic-Aspen Decline Management Response EIS

April 2015

Grand Mesa, Uncompahgre, and Gunnison National Forest
USDA Forest Service

In cooperation with:
Rocky Mountain Research Station, USDA Forest Service
Colorado Forest Restoration Institute, Colorado State University

INTRODUCTION AND BACKGROUND

In July 2013, the Forest Service published a Notice of Intent to prepare a landscape-level Environmental Impact Statement (EIS) to carry-out management actions to address a large-scale spruce beetle epidemic and aspen decline occurring on the Grand Mesa, Uncompahgre, and Gunnison (GMUG) National Forests. This project is referred to as "Spruce Beetle Epidemic and Aspen Decline Management Response (SBEADMR) EIS. Comments received through scoping and additional public meetings held in 2013 and 2014 were used to develop alternatives currently being analyzed. In May 2014, GMUG staff provided an overview of the alternatives developed during a public meeting. During the May meeting, some members of the public expressed concerns regarding the scope and scale of the project and a perceived lack of "collaboration" by the GMUG up to that point in time. Following this meeting GMUG leadership made the decision to slow the process allowing additional public involvement and encouraged establishment of a working group. The working group has been in existence since September 2014 lead by the Public Lands Partnership. The PLP has a history of engaging community leaders, concerned citizens, organized interests, and scientists to address Forest Plan and project-level planning issues on the GMUG.

The GMUG also established an agreement with the USDA Forest Service Rocky Mountain Research Station (RMRS) to collaborate with scientists at the Colorado Forest Restoration Institute (CFRI) and with the Geography program at Colorado State University (CSU), hereafter referred to as the Science Team. The purpose of this agreement is to engage the Science Team in informing dialogue and learning regarding SBEADMR implementation by providing timely, relevant science-based information to stakeholders and the GMUG throughout the life of the SBEADMR project. This science-based information will help address uncertainties and issues associated with the location, design, and effects of tree harvest and removal. Specifically, the team will complete a literature review, help with treatment prioritization, and complete monitoring studies focused on tree removal (both green-tree and dead-tree harvesting) effects on forest regeneration. These activities will facilitate the identification of "best available science" and help ensure management decisions are made based on the preponderance of scientific evidence.

The purpose of this document is to specify the phases, principles, and activities comprising an adaptive implementation framework for the SBEADMR project. The primary goal is to bring diverse groups and individuals together so that they might identify common problems and interests, and identify solutions that will facilitate the implementation of SBEADMR informed by science and stakeholder input. The following describe where, when, and how science-based information and collaboration are integrated with USFS Forest Service management decision-making for SBEADMR.

The SBEADMR project's Adaptive Implementation and Monitoring Cycle includes stakeholders meeting multiple times during each year of implementation (Figure 1). The cycle is modeled after the process used for the Uncompahgre Plateau Collaborative Forest Landscape Project (UPCFLRP) that has been in existence since 2010. In 2014 poll of 20 stakeholders involved in the UPCFLRP completed by the National Forest Foundation found 80% of respondents feel the collaborative group's participation improves the Forest Service decision making process and implementation of management actions (National Forest Foundation, 2014).

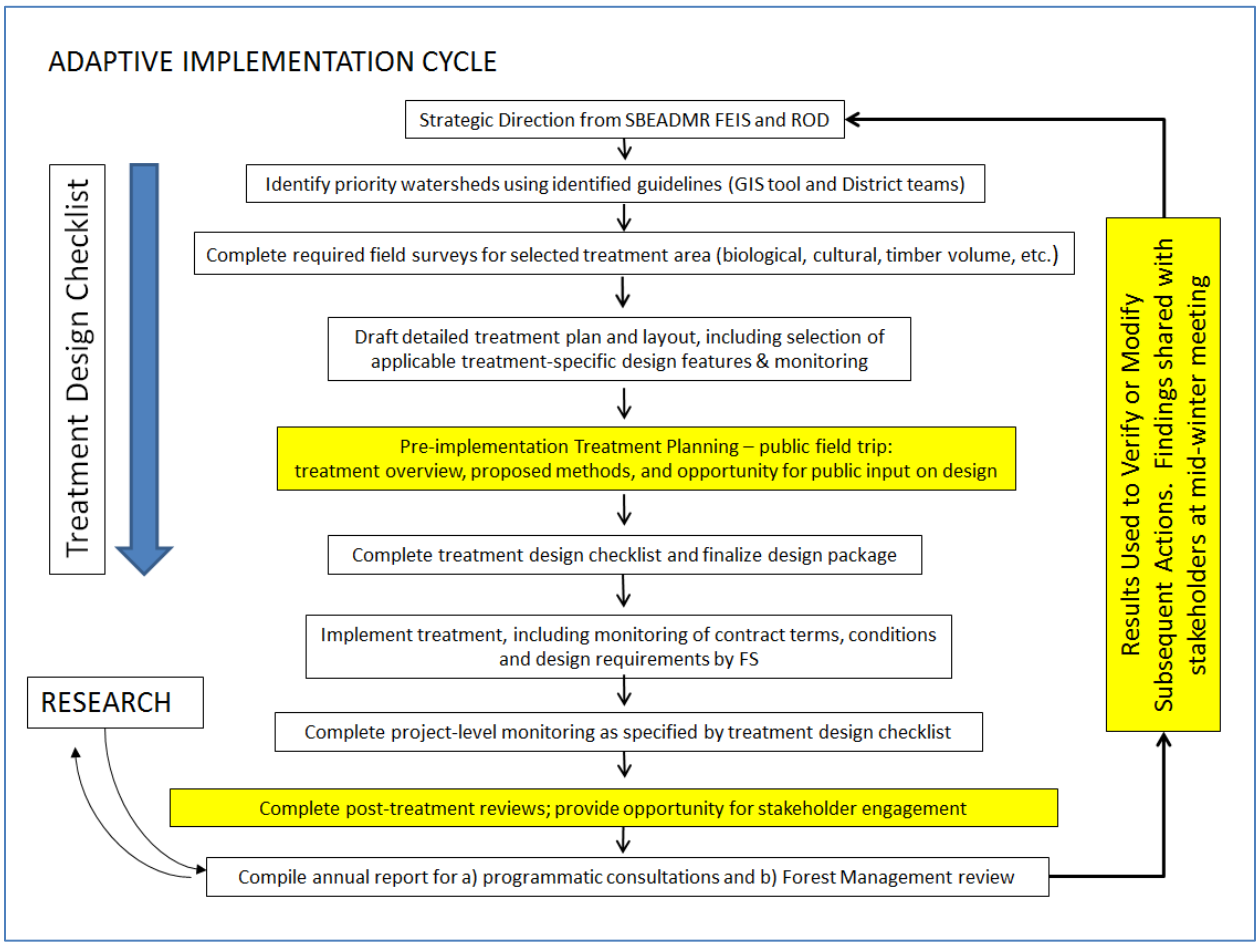

Figure 1. Adaptive implementation and monitoring cycle. Areas in yellow identify opportunities for stakeholder involvement. Details are provided below.

ADAPTIVE IMPLEMENTATION FRAMEWORK

The SBEADMR EIS relies on an adaptive implementation framework for defining treatment locations and design, defining monitoring questions, reviewing and evaluating the effects of treatments, and adjusting management towards desired conditions and away from undesirable conditions. These decision points will involve public stakeholders, the Science Team, and Forest staff. Specific phases, principles, and activities are outlined below. The intent is that this adaptive implementation framework will be utilized over a multi-year timeframe (8-12 years).

Stakeholder opportunities to influence SBEADMR implementation are outlined for each step of the process. Opportunities are confined by the sideboards of the preferred alternative, as outlined in the Final Record of Decision (ROD) and Environmental Impact Statement (EIS). Further, the Forest Service retains the authority to make final decisions related to location, extent and types of treatments planned and completed consistent with the ROD/EIS. However, if at any-time a stakeholder has a specific question or concern related to any aspect of implementation under SBEADMR, Forest staff will be responsive and take steps to accommodate stakeholder input to

the greatest extent practicable and will provide feedback to stakeholders about how their concerns were addressed. The process outlined here will be required by the ROD and stakeholder involvement will be on-going throughout the life of the project.

The adaptive implementation will include four major components:

5) **Pre-Implementation Treatment Planning;**
6) **Post-Treatment Implementation Review Focusing on Best Management Practices and Design Feature Compliance;**
7) **Annual Monitoring Review/Evaluation and New Science summary with Stakeholders and Science Team; and,**
8) **Annual Management Review.**

Many aspects of each of these components will occur concurrently, especially in years when both pre-treatment planning and post-treatment review is occurring. Figure 2 details how stakeholders, the Forest Service, and the Science Team will work together to complete all four parts of the Adaptive Implementation Framework.

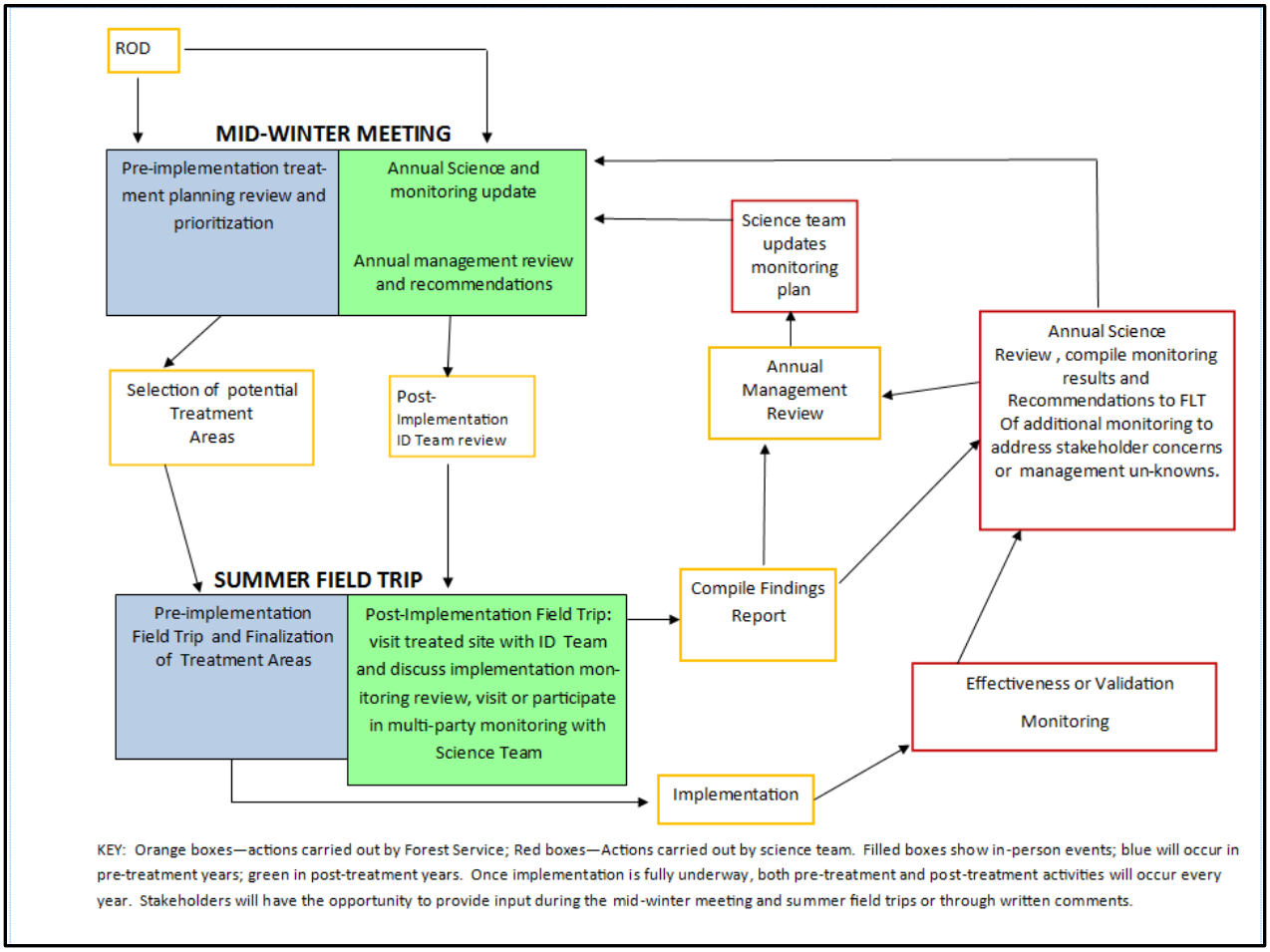

Figure 2. Diagram showing detailed relationship between stakeholder meetings (solid blue and green boxes) and Science Team (red boxes) and Forest Service (orange boxes) key activities. Blue

meeting topics will occur in pre-treatment years and green topics in post-treatment years; most years will include both topics.

1) **Pre-Implementation Treatment Planning.**

a) GIS-based tool for treatment prioritization based on participatory mapping.

The purpose the GIS participatory mapping aspect of the SPEADMR science project is to foster dialog focused on the location of planned treatments within the GMUG landscape. Treatment prioritization will be guided by stakeholder input and values identified in recent working group meetings. A GIS based mapping tool, to be developed in Summer/Fall 2015 will assist in identifying priority watersheds and potential areas that could be treated over the life of the project. The objective is to use spatial datasets (e.g. forest cover type, wildland urban interface, areas supporting an adequate transportation system to support commercial harvest, important wildlife areas, etc.) and a multi-objective, weighted optimization framework to identify and compare the suitability of different areas of the GMUG landscape to maximize benefits while minimizing potential impacts from treatments.

The Science Team will lead an initial science-focused workshop with the GMUG management team in July 2015 in which they will conduct the initial landscape-scale GIS analysis. Social and economic factors will also be a major consideration by the GMUG management team when determining priority treatment areas. The GMUG management team will provide relevant GIS layers as well as ideas from recent workshops with the SBEADMR working group on which variables to include in the analysis. The Science Team will provide maps from the initial landscape-scale analysis by October 1, 2015 for the GMUG management team to review and comment. The science team will respond to all comments from the management team and revise the initial GIS project as needed. The revised version of the GIS will be used to produce maps for the GMUG management team, working group and general public at the mid-winter meeting. The tool will be updated yearly to incorporate new scientific information from this project and others in the region, in addition to changing perspectives of the GMUG management team, general public and working group. Because of the 2-3 years needed to plan and implement treatments, GIS analyses will be focused on potential management adaptations 4-5 years in the future. Annual revisions will be presented to the GMUG management team in late fall for comment and stakeholder input will be sought at the mid-winter meeting.

Priority treatment watersheds/areas will be used to help formulate out-year (5 years) treatments and included in normal Forest Service planning process including the 5-year timber-sale program. Stakeholders will be up-dated and comments sought as treatments move from priority watersheds/areas (5 years out), to completion of required inventories (3-4 years out) to design (1-2 years out). Once final design of the project is complete, no further modification to the project will occur.

Desired Outcomes:

i. Identify potential locations for treatments in the context of achieving multiple resource objectives;

ii. Integrate scientific understanding of spruce-fir forest dynamics from this project and the scientific literature with the landscape characteristics of the GMUG to map landscape patterns of spruce-fir forest characteristics;
iii. Provide GMUG managers with spatial context for planning the location of proposed treatment;

Stakeholder Opportunities:

i. Create maps of proposed treatment areas for the public to evaluate, discuss and comment on;
ii. Stakeholder input on data the Forest Service will consider when selecting priority watersheds/treatment areas identified for out-year planning;
    Stakeholder understanding how the GIS based tool will be used throughout implementation.
iii. Stakeholder involvement in revising and parameterization of the mapping tool on an annual basis at the mid-winter meeting.

b) Annual summer field trips

Every summer stakeholders, the Science Team, and GMUG staff will get to interact on field trips. One field trip will be conducted within each of the timber management zones (where SBEADMR treatments are being planned) on the GMUG during the summer or early Fall of the year prior to planned implementation activities. The timber zones are the Gunnison Ranger District, Norwood-Ouray Ranger Districts and Grand Valley-Paonia Districts. The pre-implementation field trip may occur on the same day as a visit to post-treatment locations once they are available.

Desired Outcomes

i. Understanding of, and, where possible, agreement on, project-level treatment location areas and treatment objectives.
ii. District Interdisciplinary Team (IDT) and stakeholders identify treatment-specific resource concerns. District IDT will seek to resolve resource concerns to the greatest extent practicable.
iii. IDT-identified surveys, design features, and post-treatment monitoring questions and measures regarding these resource concerns.
iv. Allow stakeholders to participate in monitoring data collection.

Stakeholder Opportunities

Provide recommendations to District IDT concerning:
i. Input on priority watersheds selected for treatment;
ii. Input on types and locations of potential treatments;
iii. Discuss monitoring topics, questions, and priorities with Science Team and IDT;
iv. Participate in monitoring activities;

v. Applicable EIS design features to be used for the treatment. Design features are values, attributes, or actions that will be applied to a project when resource conditions indicate the need to do so. For example, presence of a goshawk nest in a proposed treatment area triggers the use of design features to protect goshawk.

Number and Frequency:

Stakeholders will provide input into the GIS treatment prioritization tool in one initial workshop. Stakeholders will discuss annual updates to the tool with the Science Team and GMUG as needed through the life of the project. Typically, any update to the tool will be discussed with stakeholders at the mid-winter meeting (see below).

One stakeholder field trip will be completed annually within each of the three timber zones.

2) **Post-Treatment Implementation Review Focusing on Best Management Practices and Design Feature Compliance.**

The GMUG led reviews will help ensure implementation occurs in compliance with the EIS, and will allow stakeholders to interact directly with the IDT to: 1) hear the evidence and reasoning behind their conclusions; and, 2) allow stakeholders and Science Team to raise additional concerns and recommendations and get related feedback from the IDT Team in the field. Reviews will be a 2-step process. Step 1 - Using Appendix D, IDT will complete an annual review of one project in each of the three timber management zones. Review will focus on compliance of treatments with the EIS/ROD requirements and effectiveness of these requirements on addressing and mitigating resource impacts or achieving a desired outcome. Step 2 will be a Stakeholder field trip to reviewed projects to discuss ID Team findings.

Desired Outcomes:

i. Demonstrate treatments are implemented in accordance with the EIS/ROD and other applicable Forest Plan policy and legal requirements.
ii. Ensure Forest accountability to stakeholders and show that projects are being implemented in accordance with the preponderance of scientific evidence through the iterative project design and monitoring cycle.
iii. Ensure Forest accountability to stakeholders that pre-treatment input was considered in treatment location, design, implementation, and follow-up.
iv. Provide specific feedback to regulatory agencies (e.g. Fish and Wildlife Service, State Historic Preservation Office, and EPA), documenting compliance with law and regulation specific to SBEADMR project.
v. Allow opportunity for discussion of IDT review with stakeholders and Science Team;
vi. Provide summary of findings and any recommended changes (from IDT and/or stakeholders) to treatment design and layout, Best Management Practices (BMPs),

design features, or other aspects of a treatment in a report submitted to the GMUG FLT. Findings, including recommendations, will be addressed during the Management Review (Step 5).

Stakeholder Opportunities:

i. Provide evaluation of whether treatment implementation met expectations with respect to pre-treatment input on BMP and Design Features.
ii. Provide evaluation about how well public input was incorporated into treatment design.
iii. Develop treatment-specific input and recommendations informed by the preponderance of scientific evidence, such as effectiveness of design features to address resource concerns.
iv. Discuss implementation review process and resource concerns with ID and Science teams while visiting a project.

Number and Frequency: Field trip to one project per timber zone annually, randomly chosen from ongoing treatments. Treatment may include commercial mechanical harvest, non-commercial mechanical harvest, or broadcast burning. In each timber zone, the visit to post-treatment locations will occur on the same trip as visits to pre-implementation sites.

3) Mid-winter Meeting - Management review and update on Monitoring Review/Evaluation and New Science summary With Stakeholders and Science Team.

Each year a mid-winter meeting will be held with the purpose of allowing FLT to hear from stakeholders, providing time to discuss new science findings and monitoring results, and updating stakeholders on project implementation. The Science Team will provide a summary of pertinent published scientific information. This summary will facilitate evaluation of individual studies within the context of the larger body of scientific literature, ensuring management decisions are based on the preponderance of scientific evidence, or the 'best available science'. The Team will also present monitoring results annually. Because we will not see treatments effects until after implementation, monitoring in the first years of the project will look at effects of already-completed treatments similar to those proposed under SBEADMR. Findings from the prior-year management review and the out-year program of work will also be presented at the meeting. Stakeholders will have the opportunity to provide feedback about the monitoring program, project implementation, and recommendations on additional science needs and adaptive changes to the monitoring program. The Science Team will work with the Forest to determine how to best incorporate these suggestions into monitoring plans and administrative studies. Additional funding may be needed to address questions outside of the original Science Team agreement. Some questions may not be addressed if funding is not available or if an effective study design is not possible.

Desired Outcomes:

i. Provide opportunities for stakeholder dialogue with the Science Team and Forest staff;

ii. Evaluate monitoring results;
iii. Report status of projects already planned/in process of being implemented;
iv. Seek input on proposed coming-year and out-year multi-party monitoring;
v. Generally, provide opportunities for stakeholders, Forest staff, and Science Team to discuss outcomes from prior-year post-implementation management review, and results from multi-party monitoring and administrative studies and their implications on project implementation.

Stakeholder Opportunities:

i. Stakeholder input on proposed out-year program of work;
ii. Input on types and location of monitoring. Participants will be invited to participate in monitoring during summer field trips;
iii. Identify applicable peer-reviewed science to be considered in annual science summary;
iv. Raise questions and make suggestions to be considered for further administrative study and multi-party monitoring;
v. Provide feedback to the Forest Service regarding prior-year Management Review and the proposed out-year program of work.

Number and Frequency: One mid-winter meeting annually.

4) **Management Review:** The management review is central to an adaptive implementation strategy. The review ensures Forest leadership is the aware of environmental, social and management issues and takes action for continual improvement and incorporation of new knowledge. The review will take into account IDT findings, stakeholder comments and Forest responses, new scientific knowledge, and monitoring results. Actions may include changes in approaches due to evolving scientific evidence, or changed conditions within the planning area.

The GMUG will complete a review of:

i. Stakeholder recommendations and the corresponding Forest responses, provided at multiple stages throughout the year (as noted in steps 1 - 3);
ii. Post-treatment IDT reviews;
iii. Information provided from multi-party monitoring efforts;
iv. New best available science summarized by the Science Team;
v. Changes in agency policy or direction;
vi. Changed conditions (such as the US Fish and Wildlife Service listing a species as threatened or endangered).

Reviewers will determine whether the reviewed information warrants modifications to SBEADMR implementation, and whether such changes are within the scope of the ROD/EIS. Outcomes of reviews will be posted to the Forest website within one month of review. The review and responses to stakeholder comments and concerns will presented at the mid-winter meeting for group discussion.

Desired Outcomes

i. Address environmental and management issues resulting from SBEADMR implementation, and clearly identify actions necessary to address environmental and implementation concerns;
ii. Examine treatment purpose and need, objectives, and against assumptions and uncertainties, changes in resource conditions in the project area, and any evolution of pertinent best available science;
iii. Transparently ensure compliance with the ROD, applicable laws/regulations, and integration of best available science throughout the life of the project.

Stakeholder Opportunities:

Stakeholder recommendations on project implementation and the Forest response to these recommendations will be published annually. Management Review findings will also be discussed and input from stakeholders and the Science Team will be sought during the mid-winter meeting. Final decision of Management Review by GMUG FLT will be applied to all future planned projects under SBEADMR.

Number and Frequency: Management review will be done by FLT in fall, following project implementation. Results of the Management Review will be posted online for stakeholder review in early winter, and presented at the mid-winter meeting.

References

National Forest Foundation, 2014. CFLRP Collaboration Indicator 2014 Survey Results. http://www.fs.fed.us/restoration/documents/cflrp/CoalitionReports/CollaborationIndicatorSurveyResults2014.pdf.