Silviculture Specialist Report

Forsythe II Project

Arapaho – Roosevelt National Forests

Boulder Ranger District

Boulder, Colorado

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Introduction

This report summarizes the potential effects on forest vegetation resources from silvicultural activities proposed for the Forsythe II Project on the Boulder Ranger District of the Arapaho/Roosevelt National Forests and Pawnee National Grassland. This assessment addresses how the different alternatives impact the forest vegetation within the project area proposed by the Forsythe II Environmental Analysis (EA) document. The report also addresses the scientific and analytical basis for the comparison of alternatives as presented in this report. This specialist report is being prepared for the Forsythe II EA.

Silvicultural Overview

The Forsythe II Project proposes to restore a healthy, diverse, and fire resilient forest structure. Stand densities and fuel loadings would be reduced in a variety of vegetation types. The project seeks to increase vertical and horizontal diversity across the landscape by implementing prescriptions that are consistent with applicable management direction and consider important variables such as topography and site productivity. Restoration and fuels reduction goals can provide for the needs of wildlife and the ecosystems they depend on, and still be carried out with consideration to societal values and concerns in an urban forest.

The project implementation would result in a forest ecosystem that is moving toward historic conditions and would be adaptable to seeable changes based on current and forecasted trends. The project area would be more resilient to disturbances and forest cover would be maintained over time. On a landscape scale, the forest that exists today would remain in the future.

The Forsythe II landscape supports a diversity of ecosystems and vegetation types consistent with the Montane Zone and lower Subalpine Zone of the northern Front Range. The interdisciplinary team identified five primary cover types (ponderosa pine, Douglas-fir, lodgepole pine, aspen, and meadows and shrublands) to use in analyzing the effects of the alternatives for the project. Dominant conifer species throughout the landscape are ponderosa pine, Douglas-fir, lodgepole pine, and limber pine with Engelmann spruce and Rocky Mountain juniper. Aspen is also common in much of the landscape, particularly in both the dry and mesic mixed-conifer forests. Each primary cover type would have appropriate prescriptions applied in order to meet the purpose of the project.

Ponderosa pine dominated stands are found across the landscape with a mosaic of vertical and horizontal stand structures. The project would enhance these existing ponderosa pine forest stands by leaving ponderosa pine and creating openings of various sizes on south and east aspects, which are more resilient to wildland fire events and drought.

Sustainable patches of Douglas-fir and other conifer species would continue to be represented on north and west aspects. Douglas-fir dominated stands are usually due to higher soil moisture on cooler more shaded northerly aspects. The project would maintain the integrity of these stands but at reduced densities because of the proximity to private residences within the wildland urban interface (WUI).

Lodgepole pine is another major vegetation component within the Forsythe II project. Lodgepole pine stands are still within the historical fire regime. These stands have closed canopies, long fire return intervals (100+ years), and experience stand replacing fires that burn with high intensity and severity. Because these stands are homogenous in nature, they become susceptible to widespread insect and disease under drought conditions. Therefore, a goal of this project is to create a diversity of age structures between lodgepole pine stands to promote resiliency in the face of future insect and disease epidemics.

Tree planting of mixed conifer species would occur in the larger openings (patchcuts and clearcuts) created with this project to promote a more diverse forest in the face of a changing climate.

Aspen stands within the project area, for the most part, have been invaded by conifers. Over time, conifers often become established and decrease the available light, moisture, and nutrients for the aspen. As the stand grows, and shade on the site increases, conifer species eventually replace the aspen. Reducing shading and competition created by conifer encroachment provides the opportunity for improved growing conditions and slows the natural successional pattern allowing for a longer retention of aspen on the landscape. Colorado's aspen forests provide essential wildlife habitat, are second only to riparian areas in terms of biodiversity richness, and provide a natural fire break. While aspen's thin, living bark makes it prone to a host of insect pests and diseases, the primary threats to Colorado's aspen forests are chronic browsing (e.g. by elk and cattle) of young aspen shoots and more recently a wave of aspen die-off ,referred to as 'sudden aspen decline', due to long-term drought. Aspen stands are generally areas of greater moisture that can reduce the intensity of wildfires.

Meadows can occur as small habitats within surrounding forested stands or as large meadow and grassland habitats. Meadows are important habitat for a variety of wildlife species, add to the biodiversity of the project area, and provide a natural fire break. Conifer encroachment into mountain meadows is common in the western United States mainly because of fire suppression. Historically, meadow habitat was maintained by natural fire. Over time, conifer encroachment can reduce meadow and grassland habitats as well as the habitat diversity they provide. Meadows generally present areas of lower fire hazards due to the lack of canopy fuels. Areas of lower intensity can allow wildfire suppression efforts to be more safe and effective.

Private property owners would continue to initiate and maintain defensible space mitigation to the standards established by the CSFS on their personal property as well as adjacent NFS lands, as needed, to be compliant with home insurance companies' policy. A specific prescription reflective of the forest cover type would be developed for each request to complete defensible space mitigation.

Forests are part of a dynamic system composed of many different facets, which people value over time. Forested landscapes are composed of a mosaic of forest patches, differing in terms of their structures and ecological processes. It has only been in the last half-century that ecologists have embraced the importance of disturbances in affecting ecological systems (O'Hara and Ramage 2013). Past management practices, the influence of the environment on site productivity and natural disturbance all play a role in the current landscape pattern of forest structure across the Front Range (Dickinson et al. 2014).

Disturbance is an important component in the forest as it affects diversity by creating different successional and habitat structural stages across the landscape both spatially and temporally. Silviculture emulates natural disturbances by attempting to mimic the same stimuli that favor certain species and the development of certain stand structures (O'Hara 2014). Stand structure affects resistance to disturbances such as insects, pathogens, and wind damage. Resistance is the ability of a stand to avoid or prevent disturbance impacts. Stand structure may have a direct effect on resistance, such as with interactions between structure and fire behavior, or it may have a more indirect effect by improving tree vigor and thereby increasing resistance to an insect or pathogen.

The structure and function of dry forest ecosystems of the western United States have changed since European American settlement in the late 19^{th} century, and generally these forests are currently more susceptible to large severe wildfires than they have been historically (Noss et al 2006, Allen et al. 2002). Historical conditions are still pertinent in a changing environment because they provide the only detailed guide we have for evaluating landscape health and designing ecologically viable fuel treatments (Reinhart et al 2008). The most limiting factor for the forests along the Front Range is soil moisture. Many climatechange scenarios predict warmer, dryer climates, which would lead to an increase in these moisture-limited forest types.

Recent research had found that the increased density of forests has reduced the number and size of canopy openings in the lower montane. The overall abundance of forested patch lengths of Front Range's montane ponderosa forest cover has significantly increased since pre-settlement conditions. Mean (average) forest cover increased from 57% to 83% (conversely openings fell from 43% to 17%, while the mean forest patch length increased from 35 to 118 meters long (Dickinson 2014). With increased forest density and the exclusion of fire, the populations and aggregations of pioneer tree species like aspen and limber pine have been reduced.

Land designations to be treated are derived from the 1997 Revision of the Land and Resource Management Plan for the Arapaho and Roosevelt National Forests and Pawnee National Grasslands. The objective is not to eliminate all tree mortality, or to maximize stand growth, but to change fire behavior at a stand level, which would reduce the risk of landscape level, high severity, and high intensity fire. Treatments are designed to make sense from an ecological and financial perspective and are consistent with relevant management direction.

Fire resilience is the ability for live vegetation to survive from fire events. Silvicultural treatments would create conditions for shade intolerant species (ponderosa pine) to become more numerous over time, in an effort to improve fire resilience across the landscape. In the event that vegetation is killed, fire effects to the soil would be low enough to sustain live vegetation. Conifer species that are shade intolerant (ie. ponderosa pine) generally have higher survival rates in fire events due to increased bark thickness, which can reduce tree trunk damage. Tree trunk damage in wildland fire events is a significant contributor to post fire mortality.

Regulatory Framework

Management direction contained within the National Forest Management Act (NFMA) (1976) Sec. 4. (d)(1), states that "it is the policy of Congress that all forested lands in the National Forest System shall be maintained in appropriate forest cover with species of trees, degree of stocking, rate of growth and conditions of stands designed to secure the maximum benefits of multiple use sustained yield management in accordance with land management plans." Furthermore, the Act requires that "All national forest lands treated from year to year shall be examined after the first and third growing seasons and certified … as to stocking rate, growth rate… Any lands not certified as satisfactory shall be returned to the backlog and scheduled for prompt treatment."

FSH 2409.12 requires that a certified Silviculturist determine if silvicultural practices are in compliance with the Forest Plan. In addition, NFMA requires that the harvesting system to be used is not selected primarily because it would give the greatest dollar return or the greatest unit output of timber. Harvest systems and silviculture treatments are designed to follow Land and Resource Management Plan (LRMP) land allocations and meet standard and guidelines described in the 1997 Revision of the Land and Resource Management Plan for the Arapaho and Roosevelt National Forests and Pawnee National Grasslands to reduce fire behavior, increase fire fighter safety, protect wildlife habitat and restore landscapes for multiple objectives.

All resource management activities described and proposed in this document would be implemented to the extent that they are consistent with applicable federal law, USDA regulations, Forest Service policies, and applicable provisions of state law. The project would follow all applicable, laws, regulations and policies.

The National Forest Management Act (NFMA) of 1976 (see below for description) requires the development of long-range land and resource management plans. The Forest Plan was approved in 1984 and later revised in 1997. The Forest Plan provides guidance for all natural resource management activities on the Forest. NFMA requires that all projects and activities be consistent with the Forest Plan, and the Forsythe II Project is consistent with the Forest Plan. The Standards and Guidelines within the Forest Plan provide project level guidance.

National Forest Management Act of 1976
The National Forest Management Act (NFMA) requires the Secretary of Agriculture to assess forest lands, develop a management program based on multiple-use, sustained-yield principles, and implement a resource management plan for each unit of the National Forest System. This act is the origin of Revision of the Land and Resource Management Plan for the Arapaho and Roosevelt National Forests and Pawnee National Grasslands completed in 1997. NFMA is the primary statute governing the administration of national forests. NFMA contains numerous Congressional findings pertaining to the management of national forests. The Forest Service has the responsibility and opportunity to assure a national natural resource conservation posture that would meet our citizens' needs in perpetuity.

Multiple Use, Sustained Yield Act of 1960
The Multiple Use, Sustained Yield Act of 1960 (Public Law 86-517) 'authorizes and directs that the national forests be managed under principles of multiple use and to produce a sustained yield of products and services, and for other purposes.' The act says that it is the responsibility of Congress that the national forests to be 'administered for outdoor recreation, range, timber, watershed and wildlife and fish purposes.

Sec. 4(a) of this act states "Multiple use" means: The management of all the various renewable resources of the national forests so that they are utilized in the combination that would best meet the needs of the American people; making the most judicious use of the land for some or all of these resources or related services over areas large enough to provide sufficient latitude for periodic adjustments in use to conform to changing needs and conditions; that some land would be used for less than all of the resources; and harmonious and coordinated and management of the various resources, each with the other, without impairment of the productivity of the land, with consideration being given to the relative values of the various resources, and not necessarily the combination of uses that would give the greatest dollar return or the greatest unit output.

Sec. 4(b) continues on to state "Sustained yield of the several products and services" means the achievement and maintenance in perpetuity of a high-level annual or regular periodic output of the various renewable resources of the national forests without impairment of the productivity of the land.

Forest Service Handbook 2409.26
The FSH 2409.26 details silvicultural activities permitted on government owned lands within the National Forest System. This handbook is the field issuance for practicing Silviculturists to apply vegetation management treatments on National Forest Service (NFS) administered lands.

Forest Service Handbook 3409.11
The FSH 3409.11 is the Forest Pest Management Handbook. This handbook is the field issuance for Forest Pest Management on NFS administered lands.

Forest Service Handbook 7709.59
The FSH 7709.59 is the roads system operations and maintenance handbook. This handbook is the field issuance for roads management on NFS administered lands.

Need for Action

On August 3, 2012 the Forsythe Fuels Reduction Project Decision Notice was signed authorizing vegetation treatments on approximately 5,005 acres (Forsythe Fuels Reduction Project Decision Notice and Finding of No Significant Impact, p. 3). The purpose for the 2012 Forsythe project was to *reduce hazardous fuels on National Forest lands that may contribute to the increased spread and intensity of wildfires and to manage increasing populations of mountain pine beetle (MPB)*. The following needs were identified as goals for the project area: 1) there is a need to apply appropriate vegetative treatments to maintain or improve watershed and forest health, reduce hazardous fuels and modify wildfire behavior in the forested areas of the project area. Treatments need to be applied in a manner and location that complement defensible space efforts on private land and/or protect other values at risk. In addition, these treatments are needed to maintain or restore ecosystem composition and structure that would reduce the risk of uncharacteristic wildfire that would be expected to occur within the current climatic period; and 2) there is a need to increase the amount and vigor of quaking aspen stands and meadows across the project area. The vegetation treatment mapping was completed using the U.S. Forest Service (USFS) corporate Geographic Information System (GIS) vegetation database. Through the analysis, the 2012 Forsythe Fuels Reduction Project Decision Notice identified, 1,706 acres of lodgepole pine treatment, 306 acres of salvage/sanitation in the lodgepole pine cover type, 1,533 acres of ponderosa pine treatment, 209 acres of aspen restoration, 283 acres of meadow enhancement, and 968 acres of prescribed broadcast burning.

During implementation of the Forsythe Fuels Reduction Project, neighborhood residents expressed several concerns with the vegetation management activities, primarily based on the mapped discrepancy. A Supplemental Information Report (SIR) was prepared in October 2014, to review the new information brought forward. The SIR focused on cover type discrepancy, treatment description as described in the Forsythe Fuels Reduction EA versus task order cutting prescriptions, and consistency of project implementation with design criteria (Forsythe Fuels Reduction Project SIR). The SIR documented that the information presented did not constitute significant new information or changed circumstances that would change the analysis of effects in the project area. However, District Ranger Sylvia Clark recommended the project implementation be halted so that additional public involvement and supplemental analysis could be conducted to utilize the more precise cover type information and location of specific treatment prescriptions to better display impacts and determine if modifications of treatments is warranted.

The Forsythe II Project was initiated under the authorities allowed in the Healthy Forests Restoration Act of 2003 (HFRA). To comply with the National Environmental Policy Act (NEPA), the Forsythe II Project EA has been prepared. This EA tiers to the Environmental Impact Statement (EIS) prepared for the 1997 Revision of the Land and Resource Management Plan for the Arapaho and Roosevelt National Forests and Pawnee National Grassland (Forest Plan). These documents, as well as detailed information from resource specialists in the project record, are available upon request from the Boulder Ranger District, Boulder, Colorado.

Proposed Action

The Boulder Ranger District proposes management activities on 3,151 acres of NFS lands within the Forsythe II Project area to meet the objectives for this project as described above. The proposed action includes 2,483 acres of mechanical/hand treatment and 968 acres of broadcast burning. A combination of mechanical/hand treatment and broadcast burning would occur on 300 acres. Additionally, 2,032 acres are analyzed for defensible space to provide permitted homeowners adjacent to NFS lands the ability to treat on NFS lands. However, it is estimated that up to 10% of the analyzed defensible space acres would be treated, or 203 acres.

Proposed management activities include thinning 1,449 acres of mixed conifer stands, patchcutting/ clearcutting 741 acres of lodgepole pine stands, thinning 17 acres of regenerated lodgepole pine stands, and cutting 276 acres of conifers within aspen and meadows/shrublands areas. Reforestation treatments (tree planting of mixed conifer species) would occur in patchcuts/clearcuts. Thinning regenerated lodgepole pine stands would occur in the future in areas patchcut/clearcut in this decision. These treatments may be done by either mechanized equipment or hand crews with chainsaws. Mechanized equipment operations are limited by the topography (percent slope and amount of rock). Units that are over 30% slope would be treated manually. However, there may be short distances within a unit where a machine could be working on slopes up to 40%.

Slash created by these treatments could be moved offsite, piled and burned, chipped, and/or masticated. Where mechanized equipment is used, forest products would most likely be removed in the form of logs, chips, or firewood. After work is completed, firewood may be removed from the hand treatment units. Temporary roads may be constructed to facilitate the vegetation management activities and would be restored after the project is complete.

To decrease the risk of erosion and sedimentation and improve hydrologic function, approximately 6 miles of System Road (NFSR) would be decommissioned and another 2.3 miles converted to administrative use only (not open to public travel). Any unauthorized roads on NFS lands not identified on the map but found during implementation would be restored. These mileages affect only the portions that cross NFS lands and take into account the transportation system necessary for public access, motorized recreation, and forest management while also accounting for the effects the roads have on the watershed.

The town of Nederland and residents of the Big Springs Subdivision requested a special use authorization for emergency ingress/egress routes to the south and east of the subdivision. Two ingress/egress routes were identified (Doe Trail, 0.72 miles, and Wildewood Trail, 0.36 miles), both currently existing as trails, that could become private roads under special use for emergency ingress/egress purposes only. Road work would be done including widening, installing gates, and cutting all trees within the 30 foot road corridor. This clearing would be approximately 3.9 acres (2.6 acres along Doe Trail, 1.3 acres along Wildewood Trail).

Project Objectives

The purpose of the Forsythe II Project is described by four objectives. The need is described in the current condition for each objective. These objectives are:

- **Objective 1 –** Reduce the severity and intensity of a wildfire within the wildland urban interface (WUI).
- **Objective 2 –** Restore ponderosa pine/mixed conifer stands, aspen, and meadows/shrublands toward their characteristic species composition, structure, and spatial patterns in order to increase resistance and resiliency to future natural disturbance.
- **Objective 3 –** Emulate natural disturbance in lodgepole pine dominated stands to mimic variable structural and spatial patterns across the landscape in order to increase resistance and resiliency to future natural disturbance.
- **Objective 4** – Provide private property landowners the opportunity to complete defensible space mitigation around their homes on adjacent NFS lands.

The objectives for this project are described using the current conditions and desired conditions with indicators to differentiate how each of the action alternatives meet these objectives. The current condition describes the state of the project area as it relates to the objective. Desired conditions do not describe a static reference condition. Rather, they highlight how a given ecosystem functions, including the dynamics and disturbance regimes that interact to sustain desired conditions over time. Well-developed desired conditions should also be forward-looking in the context of global change and should use information from the past as a guide to anticipate likely system responses to future climate and disturbance scenarios.

1.3.1 Objective 1

Reduce the severity and intensity of a wildfire within the WUI.

Indicators:

- Flame length
- Rate of spread
- Fireline intensity
- Torching index
- Crowning index
- Fire type
- Fuel hazard rating

Current Condition

The WUI has received considerable attention because of recent increases in both the number of structures destroyed and the area burned annually by wildland fire (NIFC 2004). In Boulder County, 232 houses have been destroyed and 11,941 acres have burned within the WUI in just four fires (Black Tiger – 1989, Overland – 2003, Fourmile Canyon – 2010, and Cold Springs – 2016). Increased fire activity can be attributed to at least four factors: increasingly hot and dry summers, stronger winds, insect infestations, and human population growth in forested areas.

The town of Nederland has seen a population growth of 27% since 1990 (U.S. Census Bureau, American Fact Finder). Population growth data for the areas outside the town limits of Nederland is not available, however it can be assumed that there has been a substantial increase in the areas outside of the town limits as well. On November 2, 2015 Tania Schoennagel, PhD from the University of Colorado, Boulder, made a presentation at the Boulder Public Library on the fire history and fire risk in Boulder County forests. In her presentation she provided statistics about the WUI growth of private homes in this area. According to research from Headwaters Economics, she found that there was a 35% growth in homes in the last decade, and that 60% of this zone had been developed. The WUI within Boulder County is the number one densest development in Colorado, and number 10 in the West. Within the WUI, areas of developed private lands adjacent to fire-prone forest increases wildfire risk and cost. High priorities are managing fire risk in forests in and near communities on federal and private lands (Schoennagel 2015, Boulder County CWPP 2011). It is in the WUI where protection of structures from wildland fires is most challenging (Cohen 2000, Winter and Fried 2001) and where man-caused fire ignitions are most common (Cardille et al. 2001).

Community Wildfire Protection Plans (CWPPs) developed by Nederland Fire Protection District and Boulder County outline and address the fire risk, vegetation, and fire mitigation strategies in the Forsythe II project area. Boulder County summarizes the vision of the CWPPs saying, “By actively implementing this plan, residents, communities, and organizations in Boulder County would significantly increase and improve wildfire mitigation and preparedness efforts in advance of wildfires to accurately reflect the high risk and enormous costs associated with wildfire in the county" (Boulder County CWPP 2011). Strategically addressing threats at the WUI maximizes the potential for both effective risk mitigation within developments and management for sustainable fire regimes over the broader sweep of landscapes (Moritz et al. 2014).

The subdivisions within the project area are considered high or very high risk fire hazard (Nederland Fire Protection District Community Wildfire Protection Plan). Fuel hazard across the NFS lands within the project boundary consists of 1,004 acres of low, 2,165 acres of moderate, 2,668 acres of high, and 4,093 acres of very high fuel hazard. "The highest priority watersheds…include both Gross and Buttonrock Reservoirs and the Fourmile Creek and Boulder Creek Canyon watersheds" (Boulder County Community Wildfire Protection Plan).

Mixed conifer stands in the upper montane zone are characterized by lower fire frequency and patches of stand-replacing fire in addition to low-severity surface fires (Evans, Everett, Stephens, and Youtz, 2011). The fire return interval for upper montane mixed conifer stands is 40-100+ years. Lodgepole pine stands are characterized by closed canopies, long fire return intervals (100+ years), and stand replacing fires that burn with high intensity and severity. The project area has not had a large scale fire since the early 1900's. Fire history in the project area shows 125 fires have burned 329 acres since the USFS began keeping records in 1951. Seventy percent of these fires were human caused and 86% were less than an acre in size which can be attributed to successful initial attack suppression.

Desired Condition

The desired condition for the project area is to create a condition on the landscape where fire behavior is modified to reduce the threat of a catastrophic wildfire in the direction of the values at risk. The desired condition could be achieved by reducing the surface fuel loading, increasing the spacing between tree crowns, and decreasing the canopy closure to less than 70%.

1.3.2 Objective 2

Restore ponderosa pine/mixed conifer stands, aspen, and meadows/shrublands toward their characteristic species composition, structure, and spatial patterns in order to increase resistance and resiliency to future natural disturbance.

Indicators:

- Acres treated to restore species composition, stand structure, and spatial arrangement in ponderosa pine/mixed conifer dominated stands
- Acres treated to restore aspen clones through conifer removal
- Acres treated to restore meadows/shrublands through conifer removal

Current Condition

Ponderosa Pine/Mixed Conifer

The ponderosa pine/mixed conifer cover type includes stands dominated by ponderosa pine and Douglas-fir which can occur in both the upper and lower montane zones of the Front Range. The lodgepole pine can be found in the upper montane zone. The ponderosa pine cover type is the dominant species of approximately 28% of the project area, Douglas-fir is the dominant species in approximately 25% of the project area, and lodgepole pine is the dominant species in 31% of the project area. Stands of these conifers are found in both pure stands of each conifer species as well as mixed throughout the project area.

The lower montane zone contains a variety of forests and woodlands with complex mixtures of tree species, understory species, local environmental conditions, and histories of natural and human disturbances (Kaufmann et al. 2006). This zone is dominated with ponderosa pine trees with Douglas-fir found mainly in drainages or on northerly slopes. These forests occupy the lower montane zone (5,900-8,000 feet in elevation) and are dependent on frequent (every 10 to 30 years) low to moderately intense disturbances to stay healthy (Boulder County CWPP 2011).

In the upper montane zone there is typically a striking contrast in stand density and species composition on south as opposed to north facing slopes. On xeric, south facing slopes ponderosa pine forms relatively open stands, sometimes with scattered Rocky Mountain juniper. Stands on mesic, north facing slopes are typically much denser and the relative proportion of Douglas-fir is greater (Veblen and Donnegan 2005). Boulder County's upper montane forests are some of the most diverse forests present in the county with ponderosa pine, Douglas-fir, aspen, lodgepole pine, and limber pine dominating the landscape at the lowest elevation and Engelmann spruce and subalpine fir mixing into these forests on north slopes and at the highest elevation (Boulder County CWPP 2011). Within the upper montane zone, stands dominated by ponderosa pine also occur so that this cover type extends over a broad range of abiotic and biotic conditions (Veblen and Donnegan 2005).

Past management practices, the influence of the environment on site productivity, and natural disturbance all play a role in the current landscape pattern of forest structure across the Front Range. Historically these forests were more open and heterogeneous (Kaufmann et al. 2000(a), Knight and Reiners 2000), consisting of a mosaic of openings, open woodland and closed canopy across the landscape (Kaufmann et al. 2000(b)).

Aspen

Quaking aspen can occupy a broad range of habitat types, varying from relatively xeric sites in the lower montane zone to more mesic ones in the upper montane zone (Jones 1985, Veblen and Donnegan 2005). It is present throughout the project area, but represents 5% of the forested area as aspen clones. Throughout the project area, small groups consisting of a few aspen trees exist in ponderosa pine and lodgepole pine stands. These trees are remnants of larger clones that deteriorated with the succession of conifer trees.

The productivity and development of aspen in the Front Range depends upon available moisture, which in turn is related to weather patterns, elevation, physiographic position, and soil characteristics. Younger stands of aspen are rare and found only where there has been a recent disturbance or disease outbreak to kill the overstory and trigger reproduction. Suckering is usually proportional to the amount of overstory disturbance and will be heaviest within three years after disturbance.

As a forest grows in absence of disturbance, and shade on the site increases, conifer species eventually replace the aspen making it an under-represented feature across the landscape. The aspen forests provide essential wildlife habitat, are second only to riparian areas in terms of biodiversity richness, provide a natural fire break, and provide aesthetic value to recreationists and private landowners. Individual aspen clones have been reduced in size and numbers by a variety of factors over time. Factor's contributing to aspen decline and lack of regeneration include fire suppression, livestock grazing, wild ungulate browsing and natural succession (Krebill 1972, Bartos and Campbell 1998, Gruell and Loope 1974, Mueggler 1989, Romme et al. 1995, Kilpatrick, Clause, Scott 2003).

Meadows and Shrublands

Meadows and shrublands can occur as small habitats within surrounding forested stands or as large meadow and shrubland habitats. The meadow openings represent approximately 7% of the project area and are located on southerly aspects in the eastern portion of the project area. Meadows are important habitat for a variety of wildlife species, add to the biodiversity of the project area, and provide a natural fire break. Historically, meadow habitat was maintained by natural fire; however, conifer encroachment has continued to increase into meadows.

Desired Condition

The desired condition is a fire resilient, multi-aged structure across vegetation cover types (live and dead) that represent a variety of habitats. Resilience is scale-dependent, both spatially and temporally. Any given stand may not be resilient, but the landscape as a whole may be resilient when viewed over decades or centuries (Stine et al. 2014). Ideally, the desired condition would resemble a forest structure that functioned similar to pre-settlement conditions yet adapts for fluctuations and variance in the face of a changing climate. Odion et al. 2014 found that diverse forests in different stages of succession, with a high proportion in relatively young stages, occurred prior to fire exclusion. Ecosystems may be more resistant to disturbance if species that are most adapted to the expected future conditions are favored (Janowiak et al. 2011, O'Hara 2014). Silvicultural activities that favor drought resistant species would lead to stands with greater resistance.

Restoration activities would provide a landscape-level resilience to disturbance. Changes in forest composition and configuration have led to decreased resilience to historical disturbance agents. Creating and maintaining forest and fuels structures consistent with historical fire regimes are generally thought to be sustainable on a landscape scale while providing habitat for all species within a landscape, and can be maintained with burning. Landscape resilience is even more critical in the context of climate change, where fires are projected to be larger, more frequent, and of higher severity than those in the past (Westerling 2006).

The modern landscape in the Forsythe II project provides management values and challenges that did not exist in the past including a complex land ownership pattern with structures on private land, high fuel loading, developed recreation sites and high visitor use, and primary drinking water sources for metropolitan areas.

<u>Ponderosa Pine/Mixed Conifer</u>

The Forest Plan emphases managing ponderosa pine to emulate conditions representative of a nonlethal understory fire regime. The Forest Plan further directs the restoration of natural processes through human-induced activities. These activities could include prescribed fire or mechanical treatments of vegetation to improve wildlife habitats, restore forest health, assist in the recruitment of old-growth ponderosa pine, reduce fuel loading and maintain or restore ecological conditions. Recruitment of old growth ponderosa pine would improve habitat for wildlife species such as pygmy nuthatch, an ARP Management Indicator Species (MIS), and USFS Sensitive species flammulated owl.

In the lower montane zone and on hotter, drier, south slopes, sites would be dominated with ponderosa pine. The desired stand condition would be a mosaic of trees with both horizontal and vertical structure. Conifers within these stands would be unevenly spaced across the area, sometimes in small groups with enough space between individual trees or groups of trees so that the crowns of the trees are not continuously intermingled.

Stands on cool, moist, north slopes would be predominately ponderosa pine and Douglas-fir with a mixture of other conifer species and aspen. These stands would be denser than stands on south slopes due to aspect and higher moisture levels.

Historically, openings were prevalent on south and east facing aspects, in the lower montane zone, and on gentler slopes. The findings of Dickinson's study indicate that forest managers restoring lower montane ponderosa forests on the Colorado Front Range should increase the abundance of openings through silvicultural treatments, focusing particularly on increasing the abundance of small openings (<50m long) by breaking down large contiguous patches (<50 m long) into smaller patches (<50m long) (Dickinson 2014). Increasing openings would improve wildlife habitat by providing foraging areas for species such as USFS Sensitive species flammulated owl and olive-sided flycatcher, and ARP MIS mountain bluebird. Increasing openings would also enhance foraging opportunities for elk and mule deer, both ARP MIS.

While openings should be created on all aspects, they should be predominantly concentrated on the south and east facing slopes, with greater abundance of forest patches on north and west aspects. Furthermore, in the absence of the natural mixed-severity fire regime to maintain these forest structures, forest managers should plan periodic maintenance treatments that reduce the prevalence of regeneration but allow for the creation of some new openings and regeneration of others within a dynamic shifting mosaic (Dickinson 2014).

<u>Aspen</u>

The Forest Plan provides direction to encourage the growth and expansion of aspen clones. This would increase the landscape heterogeneity and complexity and provide a greater variety of environments and increased diversity.

Aspen stands would show a range of stand structures reflective of disturbance patterns; even-aged, mixed-age, and mosaics of both may be common where relatively pure stands abut conifer and aspen-mixed conifer forests (Rogers et al. 2014). Young aspen clones would be encouraged and a greater component on the landscape because they are an under-represented feature in the absence of disturbance. Aspen stand structure would be variable with an emphasis of pure clones to reset successional processes of conifer invasion within the clones perimeters.

Aspen enhancement in wetter areas would improve wildlife habitat by providing for future decadent trees for cavity-nesting birds including USFS Sensitive flammulated owl and MIS species mountain bluebird and pygmy nuthatch. Aspen enhancement across the landscape may help to spread out ungulate browsing, allowing more aspen to grow to larger sizes where soil and moisture conditions are suitable.

<u>Meadows and Shrublands</u>

Existing meadows and shrublands would continue to be a component of the landscape. These features may be located throughout, but they would be generally found on southerly exposures, on steeper slopes and vary in size and arrangement to other landscape features. Larger meadows and shrublands would play an important role for wildlife species that need open areas for foraging or nesting, including MIS species elk, mule deer, and mountain bluebird, and also influence disturbance processes such as crown-fire, insects, and disease. Meadows and shrublands would be variable with an emphasis to reduce conifer invasion within these features in order to maintain their presence on the landscape over time.

1.3.3 Objective 3

Emulate natural disturbance in lodgepole pine dominated stands to mimic variable structural and spatial patterns across the landscape in order to increase resistance and resiliency to future natural disturbance.

Indicator:

- Acres treated to maintain structural diversity of lodgepole pine dominated stands across the project area

Current Condition

Lodgepole pine, often viewed as the archetypal post-fire species, establishes from large quantities of seed released by serotinous cones and initially grows relatively rapidly on sites of favorable habitat (Veblen and Donnegan 2005). Not all lodgepole pine forests are the same. Some forests are composed of nearly pure lodgepole pine established following large wildfires decades or centuries ago. Depending on elevation and aspect, others are mixtures of lodgepole pine associated with mixed conifer species such as ponderosa pine, Douglas-fir, limber pine, Engelmann spruce, subalpine fir, and aspen. Lodgepole pine dominated stands are generally found in the upper montane zone (western side of the project area). The lifecycle of homogenous lodgepole pine usually begins and ends with a crown fire. “Dog hair” stands are extremely dense stands where trees grow very slowly and do not vary much in size. Such exceptionally dense stands appear to reflect abundant availability of seed, favorable climatic conditions for initial seedling survival, and the lack of self-thinning of the stand (Veblen and Donnegan 2005).

Lodgepole pine stands have not departed from the historical fire regime. These stands are characterized by closed canopies, long fire return intervals (100+ years), and stand replacing fires that burn with high intensity and severity. Because these stands are homogenous in nature, they become susceptible to insect and disease under drought conditions.

Desired Condition

The desired condition for the lodgepole pine dominated stands found in the project area, would be patches of varying seral stages distributed across the area. The heterogeneous pattern of lodgepole pine stands would exhibit patches of even-aged stands mixed throughout the general forest to provide a discontinuous crown level that would provide a greater resiliency to large disturbances. Some of these patches would have other conifer species and aspen mixed with the dominant lodgepole pine stand. Where grasses and forbs grow in openings created in lodgepole, foraging opportunities would be improved for ARP MIS elk and mule deer for a period of time.

1.3.4 Objective 4

Provide private property landowners the opportunity to complete defensible space mitigation around their homes on adjacent NFS lands.

Indicator:

- Number of requested permits

Current Condition

Some private property owners have requested to complete defensible space mitigation on NFS lands in order to comply with home insurance companies’ standards to insure their personal property. Without the completion of the defensible space mitigation to Colorado State Forest Service (CSFS) Guideline standards, individuals would lose their home and property insurance. Boulder County’s “Wildfire Partners” program has assisted private landowners who live in the WUI by providing evaluations of individual properties and access to grant monies to assist in the completion of defensible space mitigation on private lands.

Desired Condition

Private property owners would continue to initiate and maintain defensible space mitigation to the standards established by the CSFS on their personal property as well as adjacent NFS lands, as needed, to be compliant with home insurance companies’ policy. Upon request, individuals would need a permit from the USFS to complete fuels mitigation on NFS lands. The permits would outline and direct private landowners of their responsibilities while treating vegetation on NFS lands. As a result of this process, Wildfire Partner’s participants and other adjacent homeowners would have the ability to complete the required defensible space across their property boundaries onto NFS lands.

Silviculture Issues

<u>Issue 1</u>

Management activities being applied to the forested stands in the upper montane zone may be inappropriate.

Background:

The WUI is any area where man-made improvements are built close to, or within, natural terrain and flammable vegetation, and where high potential for wildland fire exists (CSFS webpage 2016). The entire Forsythe II project lies within the WUI. The majority of the area that is proposed to be treated is located in the upper montane zone. In a heavy populated WUI environment, canopy separation and a modified forest structure minimizes and modifies the impacts of a devastating wildfire. Forest restoration objectives are secondary to WUI objectives in highly populated areas regardless of what life zone proposed treatments are located. Therefore, vegetation treatments within a WUI landscape would be more intensive than in areas that may be restored because of the infrastructure and houses that are at risk to wildland fire.

The proposed vegetation treatments would be applied to stands within the lower and upper montane forests of the project area. Generally, the lower montane zone ranges in elevation from 6,000 to 8,000 feet in elevation and the upper montane zone 8,000 to 9,000 feet. However, vegetation components characteristic of one zone or the other, may be found outside of the preferred elevation ranges. Vegetation patterns are complex within the project area and are influenced by a combination of factors including elevation, aspect, soils, and disturbance history.

There is limited research in the upper montane zone of the Front Range. The tree species mix is generally greater in the upper montane as compared to the lower montane zone. Historically, upper montane forests experienced mixed severity/moderate frequency fires which were correlated with drought periods and varied with topography (Schoennagel 2015). Forests in the upper montane are generally cooler and moister than the lower montane.

The lower montane zone contains a variety of forests and woodlands, with complex mixtures of tree species, understory species, local environmental conditions, and histories of natural and human disturbances. The upper montane zone represents a transition from montane to subalpine forests (Kaufmann et al. 2006). Forest management that cut and remove vegetation in these two forest zones may affect the spatial structure and forest density across the landscape.

Indicators:

- WUI fuel reduction acres treated in the upper montane zone

<u>Issue 2</u>

The proposed vegetation treatments may affect old growth (retention, inventoried, and development) integrity and large trees.

Background:

Old growth stands contain older, larger diameter trees and other structural features such as snags, down logs and gaps in the canopy layers that include patches of regeneration. Old trees were historically a major component of montane forests in the Colorado Front Range. They were an integral part of the spatial and temporal heterogeneity inherent in the ecosystem. The Forest Plan describes old growth management strategies and identified 482 acres of old growth in all tree species within the project area.

Old growth forest integrity may be impacted or enhanced by the vegetation management treatments. Treatments that remove vegetation may cause changes to all tree size classes, stand densities, and species composition. Vegetation treatments are not targeting large trees for removal; however, some large trees could be removed to create gaps in the tree canopies. The forest is a dynamic system and changes occur in forest stand structure over time, including stand behavior during and after disturbances (both natural and man-made).

Indicators:

- Old growth acres treated

Issue 3

The proposed vegetation treatments, specifically in lodgepole pine dominated stands, may be susceptible to windthrow or blowdown.

Background:

Due to the high winds in the winter and spring within the project area, units proposed for treatment, especially lodgepole pine stands, pose a high potential for windfall or blowdown of remaining trees. The highest wind risk are located on ridgetops, upper windward slopes and saddles in ridges with shallow soils. Stands with many trees with defective tree boles and root systems and dense stands growing on sites with a high water table are also susceptible to windthrow.

Indicators:

- Acres of potential windthrow or blowdown

Issue 4

Vegetation management activities may lead to increased mountain pine beetle, ips, or other insect infestations.

Background:

Many insects are found within the forests of the project area, but two insects that have the biggest impact on changing forest structure include the mountain pine beetle and pine engraver beetle. Mountain pine beetle is the most prolific insect pest in Colorado and often kills large numbers of trees during annual outbreaks (Leatherman and Crenshaw 1998). Population spikes are cyclic occurring approximately every 20 to 30 years impacting susceptible lodgepole, ponderosa, and limber pine trees. Past evidence from mountain pine beetle outbreaks are evident both within and adjacent to the project area. Most *Ips* populations are associated with slash and windthrow material. Currently, mountain pine beetle and *Ips* beetle are at endemic levels.

Indicators:

- Acres of treated area

Analysis Methodology

Background

Silvicultural activities designed for action under the alternatives impact forest vegetation through several different measures of stand conditions. Measures of stand condition that influence forest tree health include stand density (basal area, crown canopy), stand structure (crown canopy, tree size), tree and stand growth, and the overall stocking composition of the stand (trees per acre).
Density of a stand is critical in determining future stand health. Density can be expressed using several different measurable calculations. Three such measures include basal area, stand density index (SDI) and relative density (RD). Basal area density is a measure that can be expressed in terms of tree diameter and the number of trees per acre.

Basal area is the area occupied by trees above a specified diameter class, as measured at breast height. The basal area measurement is used because it is easily measured, and the results are consistent from measurement to measurement. Basal area depends on the number and size of the trees occupying the stand. Stand history and current stand conditions of the stand determine the present basal area, and crown canopy. Since basal area density is based on the current conditions of the stand, various stand descriptive conditions can describe the same basal area, and crown canopy.

For example, a stand with primarily larger trees can have the same square feet basal area as a stand with smaller trees, if the number of trees occupying the smaller diameter stand compensates for the difference each tree allocates to the measurement. Since various stand conditions can equate to the same basal area, mathematical models are generally needed to help assist in analyzing forest stands. Therefore growth models, such as the Forest Vegetation Simulator (FVS), are used by foresters to process and project measured stand data, model basal area and calculate crown canopy cover for forested stands.

Canopy cover has been used as a common measure of desired conditions in relation to wildlife habitat, fire ecology and other resources; however, in the case of forest management and forest health, this measurement remains more of an indirect measure. Direct measurement of stand crown canopy cover can be measured several different ways and is generally very time consuming. Because these measurements vary on how canopy cover is collected there is a lack of consistency between the types of measurements; they are not directly comparable. Since crown canopy cover is related to density of the stand, density of the stand in terms of square feet of basal area has been used instead of crown canopy as a measurement of stands for forest management and health. Therefore, foresters typically have related basal area density measurements through direct comparison or through statistical regression analysis to calculate stand canopy cover.

Habitat Structural Stage (HSS) is a means of describing the condition of the stand in terms of stand age, canopy closure, and average tree size and was used to measure and compare the changed vegetation condition that was predicted from each treatment for each unit.in all of the alternatives. HSS-3 represents younger stands with sapling and pole sized trees. HSS-4 stands are mature with trees with trees greater than 9 inches DBH. HSS-A represents stands with a crown closure of less than 39%, HSS-B is 40 to 69%, and HSS-C greater than 70%.

Data Collection

Vegetation and stand data was collected and disseminated for the Forsythe II Project utilizing two primary methods:

Common Stand Exam
The Common Stand Exam (CSE) protocols provide national guidance for collecting stand examination data. CSE provides one set of national data collection protocols, data codes, portable data recorder software, forms, reports, and export programs. All stand examination data is stored in a common database structure, FSVeg. Data from multiple Districts, Forests, Regions, and participating Agencies can be analyzed with ease. The CSE protocols are used to collect stand, plot, tree, surface cover, vegetation, and down woody data. This data is stored in FSVeg along with strategic grid data, insect and disease study data, FIA, and re-measured growth plot data.

Step Transects
This method can be used to gather data in a rapid fashion in order to correlate stand structure associations within a stand or treatment unit. This data can be further extrapolated to include species association, live/dead trees, and stand density (basal area) from each data collection point. This data is summarized in tables and graphs that can be used in the preparation of a treatment prescription.

Affected Environment

Overview
There are two related environmental factors that influence ecological processes and the distribution of tree species in the Colorado Front Range: elevation and moisture availability. As elevation increases, growing seasons become shorter, temperatures are cooler and precipitation is greater. Fire and other disturbances generally become less frequent at higher elevations. Changes in vegetation composition along this gradient reflect these environmental changes.

The Forsythe II Project is located on the Boulder Ranger District of the Arapaho & Roosevelt National Forests and Pawnee National Grassland. The project encompasses 18,954 acres of National Forest System lands near and adjacent to the community of Nederland, CO and Gross Reservoir. The land ownership pattern is complex with a mixture of National Forest System lands (52%), Boulder County Parks and Open Space (12%), and private lands (36%) within the project area. The Wildland Urban Intermix (WUI) designation is across the entire project area, due to the proximity to communities as well as interspersed private land ownerships. The elevation within the Project area ranges from 6,082 to 8,945 feet.

The legal location of the project area is T73W, R1S., Sections 13, 24, 25; T72W R1S., Sections 1, 2, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 33, 34; T72W R2S., Sections 3, 4; T71W, R1S., Sections 5, 6, 7, 18, 19, 29, 30; T71W R1N., Sections 31, 32; T72W R1N., Sections 35, 36. All activities included in the proposed action would be conducted on NFS lands.

Forest Plan
The Forest Plan defines Geographic areas and Management Areas within the Forsythe II Project area. Geographic Areas serve two main purposes. The first is to apply management direction that is too specific to apply across the ARNF-PNG as a whole, as either forest-wide or management area direction. The second purpose is to identify what forest-wide and management area direction would generally receive most emphasis within the area. The Geographic Areas for the Forsythe II Project can be found in Table 1.

Geographic area direction helps to focus implementation of potential projects on the most important items and helps to specify priorities among competing uses, activities, resources, or other items.

Table 1 - Geographic Areas

GEOGRAPHIC AREA	NFS ACRES	OTHER ACRES	TOTAL ACRES
Caribou	0	16	16
Lump Gulch	3,412	4,806	8,218
Sugarloaf	2,715	2,693	5,408
Thorodin	3,802	1,509	5,311
Total Acres	9,930	9,024	18,954

Management Areas define where differing kinds of resource and use opportunities are available to the public and where different management practices may be carried out. Management Areas may not be contiguous geographically. The acres associated to each management area within the Forsythe II Project can be found in Table 2.

Table 2 - Management Areas

MANAGEMENT AREA	NFS ACRES
3.5 – Forested Flora and Fauna Habitats	8,635
4.2 – Scenic Areas	406
4.3 – Dispersed Recreation	380
7.1 – National Forest/Residential Intermix	510
Total Acres	9,930

The Forest Plan provides the Management Area prescription allocations for each Geographic Area. Each Geographic Area has unique geographic boundaries; however, issues, concerns, and opportunities may be similar. The following is from the Forest Plan, as related to the proposed Forsythe II Project Need for Action, Existing Condition and Desired Condition:

Lump Gulch

 <u>3.5 – Forested Flora or Fauna Habitats - Limited Management</u>
 <u>4.2 – Scenery</u>
 <u>4.3 – Dispersed Recreation</u>
 <u>7.1 – Intermix</u>
 Goals and Desired Conditions

- Emphasis in the area is on a broad range of goals and desired conditions that include:
    - Protecting native flora and fauna

    - Enhancing forest health and reducing forest fuels and fire hazard through active vegetation management in cooperation with private landowners and state and county agencies
    - Adjusting landownership in Intermix areas in cooperation with private landowners and local jurisdictions
- Restore, maintain, or enhance mountain grassland and aspen communities on an opportunity basis. Manage ponderosa pine to emulate conditions representative of nonlethal understory fire regime. Emphasize old-growth recruitment and retention. Direct control and perimeter control are the wildland fire management strategies.
- Some restoration of natural processes through human-induced activities is anticipated, particularly in fire-dependent ecosystems. The kinds of treatments that could be considered include prescribed fire or mechanical treatments of vegetation through ponderosa pine thinning and in some cases commercial timber sales. Specific goals for these treatments include improving wildlife habitats, restoring forest health, assisting in the recruitment of old-growth ponderosa pine, reducing fuel loading, and maintaining or restoring ecological integrity. In ponderosa pine communities, these activities would occur on south-facing slopes.
- Manage the area for year-round recreational use.

Sugarloaf

<u>3.1 – Special Interest Areas – Emphasizing Use or Interpretation</u>
<u>3.5 – Forested Flora or Fauna Habitats - Limited Management</u>
<u>4.2 – Scenery</u>
<u>4.3 – Dispersed Recreation</u>
<u>7.1 – Intermix</u>

Goals and Desired Conditions

- Emphasis in the area is on a broad range of goals and desired conditions that include:
    - Protecting native flora and fauna
    - Enhancing forest health and reducing forest fuels and fire hazard through active vegetation management in cooperation with private landowners and state and county agencies
    - Adjusting landownership in Intermix areas in cooperation with private landowners and local jurisdictions
- Restore, maintain, or enhance aspen communities on an opportunity basis. Manage ponderosa pine to emulate conditions representative of nonlethal understory fire regime. Emphasize old-growth recruitment and retention. Direct control and perimeter control are the wildland fire management strategies.
- Some restoration of natural processes through human-induced activities is anticipated, particularly in fire-dependent ecosystems. The kinds of treatments that could be considered include prescribed fire or mechanical treatments of vegetation through ponderosa pine thinning and in some cases commercial timber sales. Specific goals for these treatments include improving wildlife habitats, restoring forest health, assisting in the recruitment of old-growth ponderosa pine, reducing fuel loading, and maintaining or restoring ecological integrity. In ponderosa pine communities, these activities would occur on south-facing slopes.
- Manage for year-round recreational use.

Thorodin

<u>3.5 – Forested Flora or Fauna Habitats – Limited Management</u>

Goals and Desired Conditions

- Emphasize the maintenance and enhancement of flora and fauna throughout the area.

- Restore, enhance, or maintain mountain grassland and aspen communities on an opportunity basis. Manage ponderosa pine to emulate conditions representative of a nonlethal understory fire regime. Emphasize old-growth recruitment and retention. Direct control and perimeter control are the wildland fire management strategies.
- Some restoration of natural processes through human-induced activities is anticipated, particularly in fire-dependent ecosystems. The kinds of treatments that could be considered include prescribed fire or mechanical treatments of vegetation through ponderosa pine thinning and in some cases commercial timber sales. Specific goals for these treatments include improving wildlife habitats, restoring forest health, assisting in the recruitment of old-growth ponderosa pine, reducing fuel loading, and maintaining or restoring ecological integrity. In ponderosa pine communities, these activities would occur on south-facing slopes.
- Maintain the area's recreational setting and provide for year-round recreational use.

Background

The majority of the project is located in the Montane Ecological Zone (see Figure 1). At the lower elevations where conditions are the warmest and driest, the vegetation is dominated with mixed conifer species including ponderosa pine and Douglas-fir and aspen. Patches of herbaceous and shrub vegetation mixed with ponderosa pine are scattered and located on southerly aspects. At about 8,000 feet, ponderosa pine, Douglas-fir and aspen are joined by lodgepole pine and limber pine. This species mix forms a transitional mixed conifer forest in the higher elevations of the project area. Where there is usually a persistent winter snowpack, ponderosa pine and Douglas-fir are replaced by lodgepole pine, patches of aspen and limber pine, subalpine fir and Engelmann spruce. A summary of the project areas cover type within the project area is in Table 3.

The lower montane zone (~5,900 to 8,100 ft.) comprises primarily ponderosa pine (*Pinus ponderosa*) on south-facing slopes and a mixture of ponderosa pine and Douglas-fir (*Pseudotsuga menziesii*) on north-facing slopes. The upper montane zone (~8,100 to 9,800 ft.) is composed of ponderosa pine stands on south-facing slopes along with lodgepole pine (*Pinus contorta*), aspen (*Populus tremuloides*) and dispersed limber pine (*Pinus flexilis*) trees at higher elevations (Sherriff et al. 2014). Soils in the montane zone are shallow, poorly developed, and coarsely textured derived primarily from Precambiran granitic rocks (Peet 1981).

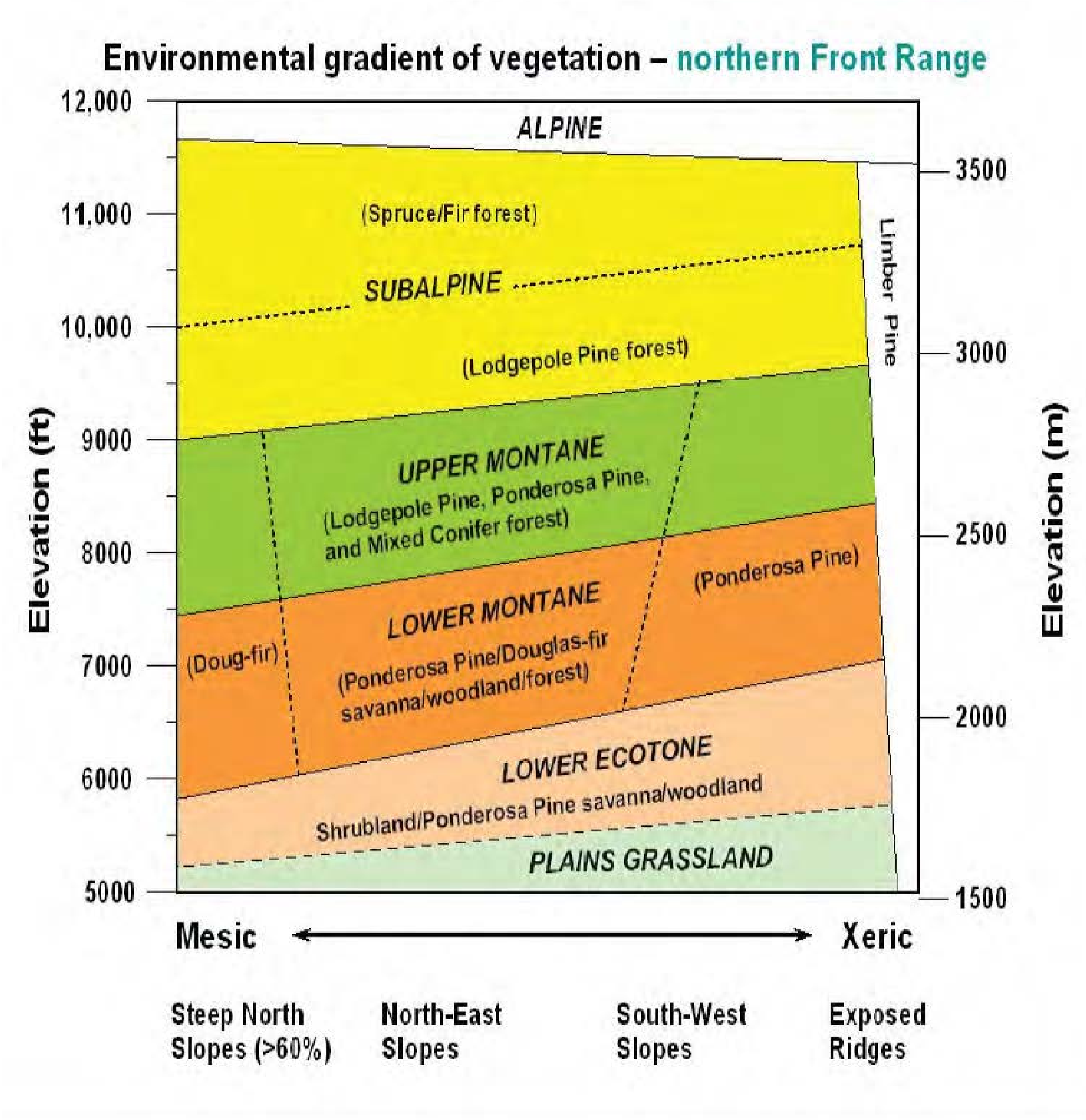

Figure 1 – Major Vegetation Zones in the Colorado Front Range (Kaufmann et al 2006, Boulder County CWPP 2011)

The slope, aspect and topographic position at low and middle elevations have a major influence on the composition of forest vegetation. Slopes that face south, west and southwest are exposed to intense sunlight and dry prevailing winds. On these warm dry slopes ponderosa pine is the dominant species. Douglas-fir is found on slopes with north aspects where conditions are generally cooler and moister.

Stand structure refers to the horizontal and vertical distribution of components of a forest stand including the height, diameter, crown layers, and stems of trees, shrubs, herbaceous understory, snags, and down woody debris. In the project area, stand structure has been influenced in the past by human uses, fire exclusion and possibly climate change. During the late 19th and early 20th centuries, logging removed the largest and oldest trees. In the lower montane and over the last 100 years as wildfire suppression became more successful, more seedlings survived than would have under a natural fire regime.

Table 3 - Major cover types and their relative percentages of within the Forsythe II Project area boundary

	Non-NFS lands		NFS lands	
Cover Type	**Acres**	**% of Area**	**Acres**	**% of Area**
Grass	992	11%	360	4%
Un-vegetated (Rock or Barren)	86	1%	47	<1%
Shrub	20	<1%	10	<1%
Quaking Aspen	666	7%	361	4%
Douglas-fir	1,475	16%	3,321	33%
Lodgepole Pine	2,647	29%	3,183	32%
Ponderosa Pine/Rocky Mountain Juniper	11	<1%	7	<1%
Ponderosa Pine	2,852	32%	2,478	25%
Spruce/Fir	17	<1%	15	<1%
Water	259	3%	148	1%
TOTALS	9,024	100%	9,930	100%

Wildland Urban Interface

The WUI is the area where structures meet or intermingle with undeveloped wildland vegetation. The WUI is thus a focal area for human-environment conflicts, such as the destruction of homes by wildfires (ie. Cold Springs Fire, Four Mile Fire, Overland Fire, Black Tiger Fire in Boulder County alone), habitat fragmentation, introduction of exotic species, and biodiversity decline (Radelooff et al. 2005). Urban and suburban development in or near wildland vegetation poses a major threat to the environment (Johnson 2001). Housing development causes habitat loss and fragmentation (Theobold et al. 1997), threatens wildlife populations (Soule 1991), and results in biodiversity declines (McKinney 2002). It has been estimated that >50% of all federally listed threatened and endangered species in the United States are in peril due to urbanization (Czech et al. 2000).

Studies show that most people living in high-fire-risk areas understand their exposure, but there is a tenuous link between understanding risk and taking action to mitigate it; whereas recognizing risk might be necessary to consider mitigation, perceived mitigation efficacy of mitigation and resource constraints can be more influential (Toman et al. 2013, Moritz et al. 2014.) An understanding of the influences on preparedness, evacuation decisions and support for hazard mitigation is needed.

On November 2, 2015 Tania Schoennagel PhD from the University of Colorado, Boulder made a presentation at the Boulder Public Library on the Fire History and Fire Risk in Boulder County Forests. In her public presentation she provided statistics about the WUI growth in private homes in this area. According to research from Headwaters Economics, she found that there was a 35% growth in homes in the last decade, and that 60% of this zone had been developed. The WUI within Boulder County is the number one densest development in Colorado, and number 10 in the West. Within the WUI, areas of developed private lands adjacent to fire-prone forest increases wildfire risk and cost. High priorities are managing fire risk in forests in and near communities on federal and private lands (Schoennagel 2015, Boulder County CWPP 2011).

The WUI has received considerable attention because of recent increases in both the number of structures destroyed and the area burned annually by wildland fire (NIFC 2004). It is in the WUI where protection of structures from wildland fires is most challenging (Cohen 2000, Winter and Fried 2001) and where man-caused fire ignitions are most common (Cardille et al. 2001). Increased fire activity can be attributed to at least four factors: increasingly hot and dry summers, stronger winds, insect infestations, and human population growth near wilderness areas.

Community Wildfire Protection Plans (CWPPs) have been developed by the fire districts, Nederland, and Boulder County that have outlined and address the fire risk, vegetation and fire mitigation strategies in the Forsythe II Project area. The vision of the CWPPs is summarized in Boulder County's, "By actively implementing this plan, residents, communities, and organizations in Boulder County would significantly increase and improve wildfire mitigation and preparedness efforts in advance of wildfires to accurately reflect the high risk and enormous costs associated with wildfire in the county" (Boulder County CWPP 2011). Strategically addressing threats at the WUI maximizes the potential for both effective risk mitigation within developments and management for sustainable fire regimes over the broader sweep of landscapes (Moritz et al. 2014).

Stand History

Activity and Disturbance History
This area has been influenced by man throughout the historical record. Ever since the Native Americans used fire as a silvicultural tool to improve wildlife habitat and increase production of their native food sources, the forest has experienced some form of management by man. Human management has intensified with the arrival of early settlers of the past to the large number of people who have moved into this area comprising today's modern day Wildland Urban Interface.

Within the project area, both live and dead fuels exist throughout the landscape in quantities that are accumulating as time passes. Vegetation successional pathways are determined by the type of disturbance regime. For a given species mix, forest and plant community development can be relatively predictable, eventually resulting in what is traditionally referred to as climax vegetation. Weather, physical setting, potential vegetation, disturbances and forest succession can determine successional pathways. (Jain et al 2012; Daubenmire 1968). The Existing Condition of the project area has been influenced by numerous anthropogenic factors throughout both recorded and non-recorded human history. This influence continues today. Shifts in species composition, and regeneration success are influenced by these influences (Gray et al 2005).

The pattern and distribution of cover types are profoundly affected by natural and man-made disturbance. Disturbance affects landscape diversity by creating different successional and habitat structural stages within a landscape. Disturbance mechanisms that are known to occur in the analysis area include insects and disease infestations, fire, and wind events. Several diseases and insects attack Front Range forests including dwarf mistletoe (*Arceuthobium vaginatum* subs. *Cryptopodium)*, mountain pine beetle (*Dendroctonus ponderosae*), western spruce budworm (*Chorisoneura occidentalis)*, and the pine engraver beetle (*Ips pini*) (See Appendix C).

Human alteration of fire regimes has had profound effects on the structure, composition, and function of forest ecosystems, especially in the ponderosa pine forests. Changes can be seen by examining the photographic time series by Veblen and Lorenz 1991. They used repeat photography to assess changes in vegetation during the last 50 to 100 years, and it is evident that tree densities have increased substantially over the last 100 years.

Past logging practices and fire suppression have shifted some stands that were historically ponderosa pine cover type into a mixed conifer cover type. Fire suppression has allowed many aspen stands to be encroached upon and replaced by conifers. Due to the techniques used to classify and map cover types, less dominant species are often under-represented. For example, even though aspen within the Forsythe II Project area is approximately 5%, there is additional aspen dispersed throughout other stands.

Dwarf mistletoe affects both ponderosa and lodgepole pine in the Forsythe II Project area. Generally the infected areas are at low to moderate levels, but there are locations of higher severity infections in both species (specifically near and surrounding Gross Reservoir). Damage to trees include a reduced growth rate, diminished wood quality, poor tree form, reduction in seed production, predisposition to insect and disease infestations, and increased mortality due to drought. Dwarf mistletoe disperses most effectively from overstory trees to smaller understory trees of the same species.

Mountain pine beetle and the pine engraver beetle are evident in pockets throughout the analysis area, but not in epidemic proportions at this time. Mountain pine beetle is the most prolific insect pest in Colorado and often kills large numbers of trees during annual outbreaks (Leatherman and Cranshaw 1998). Most *Ips* populations are associated with logging slash and windthrow material.

Although wind is not a primary cause of damage to ponderosa pine in this analysis area, it can be damaging locally, especially in mature to over-mature stands during windstorms accompanied by heavy precipitation. High wind risk areas generally are located on ridgetops, upper windward slopes and saddles in ridges with shallow soils. Stands with many trees with defective tree boles and root systems and dense stands growing on sites with a high water table are also susceptible to windthrow.

Limber pine is susceptible to the non-native pathogen, white pine blister rust (*Cronartium ribicola*). White pine blister rust is a branch and stem canker disease of five-needled pines. Damage includes mortality, top kill, branch dieback, and predisposition to attack by other agents, including bark beetles. The pathogen is exotic and has not co-evolved with its hosts; consequently, the five-needle pines have all but been eliminated in some areas and their numbers seriously reduced in others. Because of the importance of five-needle pines as elements of forest diversity, interest is high in managing white pine blister rust. Although there is currently no white pine blister rust detections in the Forsythe II Project area, the disease has been identified near the town of Ward.

Past Activities in the Forest Activity Tracking System (FACTS)
Recent treatments that have occurred within the project boundary on NFS managed lands are recorded in the FACTS database. Within the project area, the database indicates that there are approximately 2,500 acres of treatment that have been recorded. These treatments are not unique to each acre; a combination of treatments may overlap acres. Vegetation treatments have been implemented prior to 1970; however, the treatments that are recorded in FACTS started in 2004 through the present.

Existing Condition/Description of Vegetation Resource

Vegetation within and adjacent to the Forsythe II Project area is a mosaic strongly affected by past disturbances (wildfires, timber harvests, prescribed fire, fuels treatments, wind/snow damage), site quality and secondary succession.

Vegetation classifications for analysis were stratified based on the major vegetation cover type and habitat structural stage. Table 4 displays the major cover types within the project area, the relative percentages, and the major cover types within the treatment units and the relative percentages. These cover types are interspersed throughout the landscape, and within treatment units. These types are further discussed and described and analyzed within the other specialist reports, as part of this project.

Table 4 - Acres of existing vegetation in the project area on NFS lands by habitat structural stage (HSS). HSS refers to tree age and extent of canopy closure created by trees.

	1M	2T	3A	3B	3C	4A	4B	4C	TOTAL
Aspen		31	149	109	41	9	22		**361**
Douglas-fir			259	715	1,095	286	458	508	**3,321**
Lodgepole		235	186	1,262	761	116	564	59	**3,183**
Pinyon/Juniper			7						**7**
Ponderosa		27	540	707	18	594	592		**2,478**
Spruce/fir							15		**15**
Grass/Shrub	370								**370**
Rock/Water									**195**
TOTAL	**370**	**293**	**1,141**	**2,793**	**1,915**	**1,005**	**1,651**	**567**	**9,930**

Ponderosa pine – PP; Douglas-fir – DF; Lodgepole pine – LP; Aspen – As; Meadows/Shrublands - MS

1M = grasses/forbs; 2T = trees under 0.9" diameter breast height (dbh); 3A = trees 1.0 – 8.9" dbh, cover percent <40; 3B = trees 1.0 – 8.9" dbh, cover percent >= 40 and <=70; 3C = trees 1.0 – 8.9" and cover percent >70; 4A = trees >8.9" dbh and cover percent <40; 4B = trees >8.9" dbh, cover percent >= 40 and <=70; and 4C = trees >8.9" and cover percent >70.

Lodgepole pine

Lodgepole pine represents 31% of the cover type in the project area (NFS and non NFS lands). Lodgepole pine is generally regarded as an even-aged, single storied forest, varying in age from any specific location but uniform in age within any given stand. Most of the lodgepole pine stands are even-aged ranging from 7 to over 100 years of age. Stand structure varies dramatically from small diameter (two to three inch DBH), densely stocked "dog-hair", to stands where the average diameter is 6 to 10 inches DBH with 500 to 900 trees per acre. Tree heights in dog-hair stands rarely exceed 30 feet. On better quality sites with deeper soils, average tree heights range from 30 to 50 feet.

In the upper montane portion of the project area where lodgepole pine is the dominant species, stand-replacing fires created stands dominated by lodgepole pine. Lodgepole pine establishes from large quantities of seed released by serotinous cones and initially grows rapidly on sites of favorable habitat. Lodgepole pine stands have not departed from the historical fire regime. These stands are characterized by closed canopies, long fire return intervals (100+ years), and stand replacing fires that burn with high intensity and severity. Because these stands are homogenous in nature, they become susceptible to insect and disease under drought conditions. Creating a diversity of age structures between lodgepole pine stands would promote resiliency in the face of future insect and disease epidemics. Overall forest resilience to multiple disturbances can be increased when younger trees are a substantial component of the landscape (Taylor et al. 2006).

Some lodgepole pine stands across the project area that are classified as old growth. These stands can occur as inventoried old growth, retention old growth, and old growth development as described in the Forest Plan.

There is a high degree of variability in the percentage of trees with non-serotinous cones that is linked to disturbance history. Older stands tend to have higher percentages of open or non-serotinous cones. Following stand replacing fire at less favorable sites, or where insufficient seed quantities are available, seedling establishment and growth may be slower, and tree recruitment may occur over periods of 30 to 50 years.

“Dog hair” stands are extremely dense stands where trees grow very slowly and do not vary much in size. Such extremely dense stands appear to reflect abundant availability of seed, favorable climatic conditions for initial seedling survival, followed by lack of self-thinning within the stand. Lodgepole pine seedlings and saplings are very dense in past harvest openings and sparse in closed canopy overstory stands.

The majority of the lodgepole stands in the project area are self-perpetuating where the stands are dominated by lodgepole and sometimes aspen. Some stands located in the higher elevations of the project area contain Engelmann spruce and subalpine fir. In these stands lodgepole is a seral species with subalpine fir being the climax species.

Ponderosa pine/Mixed conifer

The ponderosa pine cover type represents approximately 28 % of the project area. Ponderosa pine is one of the most wide-spread tree species in the western United States. In the Colorado Front Range, ponderosa pine grows from the border of the prairie and foothills, up to around 9,000 ft. elevation, depending on topography. The majority of the ponderosa pine stands are mixed in age, density, and structure across the landscape.

On south aspects, ponderosa pine grows in relatively open stands and requires full sunlight to grow well. When stands are dense and trees shade one another, the shaded trees grow slowly, often develop poor form, and may die. In pure stands of ponderosa pine, there may or may not be an understory of reproduction depending on the density of the overstory.

Most ponderosa pine stands are mixed with Douglas-fir in the central portion of the project area and on north aspects. With the absence of fire in some locations, Douglas-fir has become dominant on the site due to its tolerance to shade and prolific seeding ability, even on south aspects.

Within the lower montane portion of the project area, it is common to see dense groups of trees (many trees growing in close proximity to each other) that have resulted from conditions favorable for tree regeneration to occur. Conditions where ponderosa pine trees establish include a large seed crop, a seed bed disturbed by fire or logging and several years with above average moisture. In the Northern portion of the Colorado Front Range these events are rare and may occur three to four times per century. Good seed crops are produced only every 4 to 6 years, with almost no viable seed produced in intervening years (Shepperd et al 2006(a)).

Surface fires can affect these groups in variety of ways. Higher intensity fires often kill most of the trees. Moderate intensity fires might creep through the clump killing some of the trees. Light intensity fires may burn around the clump leaving it undisturbed allowing all of the trees to survive. In the absence of fire, most of these young trees have survived creating stands of very dense forest. Dense stands with ladder fuels increase the chances of a crown fire and high tree mortality during fires occurring in any burning conditions.

Mature ponderosa pine in the project area generally averages 12 to 16 inches in diameter at breast height (DBH) and 40 to 50 feet total height. Occasionally, larger trees greater than 20 inches DBH are found, usually in drainages where optimal growing conditions exist.

Douglas-fir/Mixed conifer

The Douglas-fir cover type covers approximately 25% of the project area. The *Pseudotsuga menziesii* (Douglas-fir) series occurs exclusively on steep north-facing slopes of the foothills and montane zones of the Arapaho and Roosevelt National Forests at elevations of 5,470 to 8,530 feet (1,750 to 2,600 m) (Hess and Alexander 1986). Where Douglas-fir and ponderosa pine co-occur in the same stand and on aspects favorable for moisture conditions, there is a tendency for the Douglas-fir to slowly, successionally replace the pine. Douglas-fir trees are more numerous in the Front Range than they were historically (Kaufmann et al 2000(a)).

In relatively old post fire stands, young Douglas-fir is typically present whereas juveniles of the shade intolerant ponderosa pine are scarce or absent. This successional pattern is due in part to the differences in shade tolerance of the two dominant species and because Douglas-fir is a prolific seed producer the species has a competitive advantage. Within the project area, these stand types were probably less influenced by frequent surface fires. Conversely, in the upper montane zone, stand structures have been shaped by severe fires (stand replacing or partial stand replacing) occurring at intervals usually much greater than 50 years.

Quaking Aspen

Quaking aspen can be found throughout the project area in patches and stands and represents 5% of the forested area. It is the most widely distributed tree species in North America. Aspen forests are a crucial component of many western landscapes, providing biological diversity, critical wildlife habitat, valuable grazing resources as well as highly desirable scenic and hydrological values (Shepperd et al 2006(b)). The majority of the quaking aspen stands are seral communities that would eventually be dominated by conifers in the absence of a major disturbance.

As a result of fire exclusion, aspen stands within the project area, for the most part, have been invaded by conifers. Over time, conifers often become established and decrease the available light, moisture, and nutrients for the aspen. As the stand grows, and shade on the site increases, conifer species eventually replace the aspen. Reducing shading and competition created by conifer encroachment provides the opportunity for improved growing conditions and slows the natural successional pattern allowing for a longer retention of aspen on the landscape. While aspen’s thin, living bark makes it prone to a host of insect pests and diseases, the primary threats to Colorado’s aspen forests are chronic browsing (e.g. by elk and cattle) of young aspen shoots and more recently a wave of aspen die-off (referred to as ‘sudden aspen decline’) due to long-term drought. Aspen stands are generally areas of greater moisture that can reduce the intensity of wildfires.

Disturbance is required to maintain the open habitat needed for survival and to stimulate suckers for regeneration. The ability of quaking aspen to grow in full sunlight and regenerate via root suckers allows it to thrive following disturbance. Quaking aspen is well adapted to the frequent, low intensity fire regimes that existed in western landscapes prior to European settlement. Periodic fires in the past cleared away competing conifers and allowed aspen to maintain its presence across these landscapes. Fire exclusion, in combination with conifer encroachment have created conditions within the project area that have resulted in quaking aspen decline. Despite its wide distribution, quaking aspen is declining throughout the west, due in large part to fire suppression, conifer encroachment and browsing by domestic and native ungulates (Bartos and Campbell, 1998).

The clonal habit of quaking aspen adds to its uniqueness among tree species. A clone can occupy over 200 acres and have up to 50,000 genetically identical stems that can all trace their common heritage to a single aspen seedling that may have germinated millennia ago (Barnes 1975). Because of this even the most decadent clones need to be recognized as superior genotypes that have survived the process of natural selection and are the best suited genetic material for that site (Campbell and Bartos 2001). In a properly functioning condition, quaking aspen would often have multi-aged stems in the stand, adequate regeneration to perpetuate the stand, age classes mostly less than 100 years old, and good undergrowth beneath the canopy (Campbell and Bartos 2001).

The productivity and development of quaking aspen in the Front Range depends upon available moisture, which in turn is related to weather patterns, elevation, physiographic position, and soil characteristics. Younger stands of quaking aspen are rare and found only where there has been a recent disturbance or disease outbreak to kill the overstory and trigger reproduction. It is self-thinning and susceptible to disease infections that enter through wounds in the bark. Suckering is usually proportional to the amount of overstory disturbance and would be heaviest within three years after disturbance.

Colorado's aspen forests provide essential wildlife habitat, are second only to riparian areas in terms of biodiversity richness, and provide a natural fire break. Younger aspen stands are often under-represented due to fire exclusion and encroachment of more shade tolerant conifers (Addington et al Draft). Aspen stands are described as areas where aspen stems greater than two inches DBH exceed the number of conifers in the stand.

Throughout the project area, small remnant aspen clones are found in ponderosa pine and lodgepole pine dominated stands. These trees are remnants of larger clones that deteriorated with the succession and competition from conifers.

A combination of mechanical treatment and prescribed fire is usually the best course of action to regenerate aspen in mixed aspen-conifer stands. A combined treatment can provide a means of emulating natural fire regimes by providing maximum hormonal stimulation and optimal growth environments for aspen suckers as well as eliminating or reducing competing conifers (Shepperd 2001). The proposed action would remove all competing ponderosa pine trees up to 16" DBH. These trees are compromising the existing aspen clone by either shading the clone, prolifically seeding within the clone, or directly competing for soil moisture. In effect, the conifers are reducing sunlight and moisture levels. Since quaking aspen are early seral species, lack of an active disturbance regime has allowed the conifers to gain superior crown position that is leading to further growth of the conifers, and reduction of the aspen clone.

Meadows and Shrublands

Meadows and shrublands can be found throughout the project area in small patches that represent 7% of the project area. Meadows and shrub patches can occur as small habitats within surrounding forested stands or as large meadow, shrubland, and grassland habitats. Meadows and shrublands are important habitat for a variety of wildlife species, add to the biodiversity of the project area, and provide a natural fire break.

Conifer encroachment into mountain meadows and shrublands are common in the western United States mainly because of fire suppression. Historically, meadow habitat and shrublands were maintained by natural fire. Over time, conifer encroachment can reduce meadow, shrubland, and grassland habitats as well as the habitat diversity they provide. Meadows generally present areas of lower fire hazards due to the lack of canopy fuels. Areas of lower intensity can allow wildfire suppression efforts to be more safe and effective. Associated soil type changes are also resulting from vegetation community changes, due to changed soil chemistry and other factors. The size and extent of meadows is less. Meadow areas are important habitat components, and also have hydrologic significance.

Prescribed fire is an effective tool to restore vegetative communities and to protect values threatened by wildfire. In addition, prescribed fire effects approximate the effects of natural fires in mixed conifer ecosystems (Nesmith et al. 2011). A prescribed burn can reduce loads of fine fuels, duff, large woody fuels, rotten material, shrubs, and other live surface and ladder fuels, and hence change the potential spread rate and intensity of a future wildfire (Graham et al. 2004). Prescribed burning is an essential tool in reducing fire behavior across the landscape as well as reintroducing fire back into the ecosystem. "Historically, many dry forests dominated by ponderosa pine and Douglas-fir were frequently (4 to 25 years) burned by low intensity surface fires" (Graham et al. 2004).

Old Growth and Old Growth Development

There is approximately 3,300 acres (NFS and non-NFS lands) of existing and developing old growth within the Forsythe II Project area. Old growth forests within the Forsythe II landscape are distinguished by groups of old trees and the related structural features such as snags, down logs and gaps in the canopy layers that include understory patches. Large, declining live trees are considered a necessary part of all old growth stands. Old trees were historically a major component of montane forests in the Colorado Front Range. They were an integral part of the spatial and temporal heterogeneity inherent in the ecosystem. Now they are relatively scarce across the landscape. Surviving old trees are now stressed by competition from dense ingrowth of younger trees and are in danger from insect outbreaks and stand-replacing fires (Huckaby et al. 2003).

Ponderosa pine is a long-lived species. The oldest known ponderosa pines in the Front Range are a little over 600 years old. However, ponderosa pines that old are uncommon in the Front Range. Trees between 300 and 500 years old are frequent, and trees more than 200 years old are common throughout the Front Range above about 6500 feet elevation (Huckaby et al., 2003). Stands of old growth ponderosa pine are relatively rare because of past logging and wildfire; however, individual trees older than 200 years are not uncommon and trees that were too small to cut during the Euro-American settlement period are now around 200 years old.

There are approximately 107 acres of seral lodgepole pine old growth in the Forsythe II project area. The seral lodgepole pine condition can exhibit old-growth characteristics albeit they not last long in one place, but overall in a landscape this old-growth condition can exist for quite some time (Mehl 1992). In a seral condition lodgepole pine old growth would be described as having an overstory of large old trees without lower limbs, with dead or dying tops and with crowns that are sparse, open branched and somewhat flattened.

The Forest Plan divides old growth into three distinct categories (see Table 5): existing old growth (inventoried), old growth retention, and old growth development. Inventoried old growth areas are those that have been inventoried and meet the definition used in the Forest Plan. Management is generally allowed to retain the character of these inventoried stands; however, treatments are not allowed in inventoried lodgepole pine or spruce-fir old growth stands in areas with a Forest Plan management designation of Forested Flora and Fauna Habitats (3.5) (USDA Forest Service 1997).

Old growth retention areas are identified within the timber suitability analysis and have specific limitations for treatment. Identified old growth development areas are estimated to become old growth stands within the next century in the absence of a stand replacing event. Management is allowed in developing old growth areas as long as the treatment objective supports old growth development. On the Arapaho-Roosevelt NFS, inventoried old growth was identified, as a minimum rule, as large live trees, some of which were old and declining; either snags or fallen trees; and greater than 20 percent overhead canopy closure (Lowry, 1992).

Table 5 - Old Growth Classifications within the Forsythe II Project Area and Units by Alternative

		*ALTERNATIVE 1			*ALTERNATIVE 2			*ALTERNATIVE 3			*ALTERNATIVE 4		
OLD GROWTH CLASSIFICATION	(1) TOTAL OLD GROWTH ACRES IN PROJECT AREA	VEG TX ACRES	VEG TX & RX BROADCAST BURN ACRES	TOTAL TREATED OLD GROWTH ACRES	VEG TX ACRES	VEG TX & RX BROADCAST BURN ACRES	TOTAL TREATED OLD GROWTH ACRES	VEG TX ACRES	VEG TX & RX BROADCAST BURN ACRES	TOTAL TREATED OLD GROWTH ACRES	VEG TX ACRES	VEG TX & RX BROADCAST BURN ACRES	TOTAL TREATED OLD GROWTH ACRES
Retention	33.76	33.62	0	33.62	12.89	0	12.89	13.03	0	13.03	33.62	0	33.62
Development	1908.71	422.31	116.08	538.39	384.33	114.52	498.85	332.38	114.40	446.78	422.31	116.08	538.39
Inventoried	274.54	34.77	3.70	38.47	33.51	3.70	37.21	5.50	3.70	9.19	34.77	3.70	38.47
Development & Retention	937.33	225.96	0.05	226.02	198.43	0.05	198.48	223.30	0.05	223.35	225.96	0.05	226.02
Development & Inventoried	109.43	8.91	0.01	8.92	8.91	0.01	8.92	0.03	0.01	0.04	8.91	0.01	8.92
Inventoried & Retention	44.35	44.35	0	44.35	30.73	0	30.73	2.10	0	2.10	44.35	0	44.35
Inventoried, Development & Retention	44.13	0	0	0	0	0	0	0	0		0	0	0
TOTAL ACRES	**3352.24**	769.92	119.84	**889.76**	668.80	118.28	**787.07**	576.34	118.15	**694.49**	769.92	119.84	**889.76**

Generally, larger live trees, snags and large downed woody material would be retained.
In ponderosa pine dominated mixed conifer stands, many of the designated old growth development stands within the analysis area are lacking a ponderosa pine regeneration component (seedlings) that would perpetuate the stand over time. These stands are even-aged and lack openings needed for seedlings to establish. Aggressive fire suppression practices for the past 100 years have removed the natural disturbance mechanism that has sustained a healthy dynamic cycle of stand development.

Between fire exclusion and dwarf mistletoe, Douglas-fir has established in the understory and further increased competition for water, nutrients, and sunlight. Over time, without any fire or management, ponderosa pine stands may convert to Douglas-fir. These stand conversions often result in a less fire resistant stand that is prone to a crown sustaining fire.

Instead of a healthy, sustainable condition of multi-aged trees, many stands have an overstory of mixed conifer species with a dense understory of shade tolerant seedlings and saplings that provide ladder fuels to the crowns of larger trees. If and/or when a fire passes through one of these old growth stands and rises into the crowns, it may set the stand back 150 to over 300 years to an early stand-age condition.

Where persistent old growth stands exist, there are some very old trees with no evidence of a stand initiating event. They are characterized by a continuum of tree ages, including trees more than 400 years of age, old trees dying from micro-scale disturbances such as dwarf mistletoe, windthrow, or lightning strike, and coarse woody debris on the ground. Fire scars are sometimes present, indicating that surface fires have burned in the stands without killing all of the trees.

Defensible Space

Defensible space mitigation is implemented for structure protection. Creating defensible space ensures that all live/dead vegetation are sufficiently spaced from structures to limit fire spread, as well as damage from radiant heat as outlined by the guidelines developed by the Colorado State Forest Service. Defensible space treatments are limited in scope and size. Reducing fuel loads around structures can reduce the likelihood that they would be damaged by fire. Defensible space gives firefighters more opportunity to safely engage the fire and protect the structure. Wildland firefighters may not be able to engage the fire in areas without defensible space, due to safety concerns.

The primary objective in creating defensible space is to lower fire severity and intensity near a particular structure. The intensity of the treatments would vary based on the distance from the protected structure, with the most intense prescriptions occurring in the closest proximity to the structure. As distance from the protected structure increases, fuels prescriptions would change and may be able to incorporate additional objectives such as restoration.

The vegetation that is present within the defensible space is characteristic of the general forest matrix. At the lower elevations of the project area, the vegetation is dominated by a ponderosa pine forest. The ponderosa pine forest typically becomes mixed with Douglas-fir and aspen at higher elevations. At about 8,000 feet, ponderosa pine, Douglas-fir and aspen are joined by lodgepole pine and limber pine. This species mix forms a transitional mixed conifer forest in the higher elevations of the project area. Where there is usually a persistent winter snowpack, ponderosa pine and Douglas-fir are replaced by lodgepole pine, patches of aspen and limber pine, subalpine fir and Engelmann spruce.

Desired Condition

The desired condition for the vegetation resource, including fuels is a fire resilient, multi-aged structure across vegetation cover types that represent a variety of habitats. Ideally, this condition would resemble a forest structure that functioned similar to pre-settlement conditions yet adapts for fluctuations and variance in face of a changing climate. Odion et al. 2014 found that diverse forests in different stages of succession, with a high proportion in relatively young stages, occurred prior to fire exclusion.

The desired condition would enhance high levels of horizontal (openings, individual trees and groups of trees) and vertical (tree seedlings to mature trees) diversity with both live and dead trees that exist within large-scale watershed landscapes. Varying relative densities are apparent across the landscape both spatially and temporally. Areas would maximize growth, while yet other places would continue to perpetuate crowded conditions effectively providing more canopy cover and snag (dead tree) recruitment through time.

Well-developed desired conditions should also be forward-looking in the context of global change and should use information from the past as a guide to anticipate likely system responses to future climate and disturbance scenarios (O'Hara 2014). Ecosystems may be more resistant to change if species that are most adapted to the expected future conditions are favored (Janowiak et al. 2011, O'Hara 2014). Silvicultural activities that favor drought resistant species would lead to stands with greater resistance.

Parameters of fire regimes, including fire frequency, spatial extent of burned areas, fire severity, and season of fire occurrence, influence vegetation patterns over multiple scales (Brown et al. 1999), and are controlled by vegetation type, slope aspect, slope steepness, topographic position and fire frequency (Taylor and Skinner 2003, Beaty and Taylor 2001, Fites-Kaufman 1997). Disturbance processes dramatically declined following the onset of fire exclusion, suggesting fire was the primary disturbance agent (Odion et al 2014). These studies suggest forest landscapes varied depending on fire frequency and intensity, which is largely controlled by fuels and topography. Resulting forest structural conditions vary based on these factors (North et al 2009).

The Forsythe II Project seeks to re-establish ecosystem process and structures similar to those consistent with mixed to high intensity fire regimes. Creating and maintaining forest and fuels structures consistent with historical fire regimes are generally thought to be sustainable on a landscape scale while providing habitat for all species within a landscape, and can be maintained with burning. However, the modern landscape in the Forsythe II Project provides management values and challenges that did not exist in the past including a complex land ownership pattern with structures on private land, high fuel loading, developed recreation sites and high visitor use, and primary drinking water sources for metropolitan areas.

Almost the entire Forsythe II Project area is identified as wildland urban interface (WUI). Research has shown that thinning treatments at higher elevations of the montane zone will not return the fire regime to an historic low-severity, regime, and are of questionable effectiveness in preventing severe wildfires (Sherriff et al. 2014). In a heavy populated WUI environment, canopy separation and a modified forest structure minimizes and modifies the impacts of a devastating wildfire. Thinning, clearcuts and patchcuts would not prevent a wildfire but it would reduce the severity and intensity of a wildfire by modifying the fire progression. Forest restoration objectives are secondary to WUI objectives in highly populated areas regardless of what life zone proposed treatments are located.

Therefore, vegetation treatments within a WUI landscape would be more intensive than in areas that may be restored because of the infrastructure and houses that are at risk to wildland fire. In an area without the WUI structure in the upper montane, the forest may not need restoration treatments because it may be within the historical range of variability. However, a fire similar to the Cold Springs Fire that occurred in July, 2016 in a WUI environment, devastating results can occur with the loss of homes and infrastructure.

Attention has focused on silvicultural strategies to promote heterogeneous stands and landscapes with greater resilience. This trend coincides with an on-going discourse on the role of silviculture as a mechanism for sustaining and enhancing forest complexity (Keyes et al. 2014, Puettmann et al. 2010, Seymour and Hunter 1999). It is also consistent with the current nationwide emphasis on promoting the resilience of public lands. Enhancement of ecosystem resilience is a formal Climate Change Adaptation goal of the USDA (USDA Forest Service 2008), with novel treatments that enhance stand structure diversity being considered especially important in the face of likely increases in disturbance events under a dynamic and changing future climate (Keyes et al. 2014, Gillette et al. 2014, Bentz et al. 2010, Raffa et al. 2008, Westerling et al. 2006).

Almost the entire Forsythe II Project area is identified as wildland urban interface (WUI). Forest restoration objectives are secondary to WUI objectives in highly populated areas regardless of what life zone proposed treatments are located.

The desired condition for the Forsythe II Project across the landscape incorporates the objectives of a healthy forest in a WUI environment that is resilient over time and involves restoration activities where appropriate while allowing for vegetation changes that may be altered in a changing climate.

Restoration

Restoration activities would provide a landscape-level resilience to disturbance. Changes in forest composition and configuration have led to decreased resilience to historical disturbance agents. Landscape resilience is even more critical in the context of climate change, where fires are projected to be larger, more frequent, and of higher severity than those in the past (Westerling 2006). Meeting “pure” restoration objectives in some locations given the appropriate vegetation type may or may not be possible especially in highly populated WUI environments because the vegetation treatments needed in order to meet restoration goals are highly variable in relation to the proximity of the WUI and a broader forest matrix.

Resiliency

The concept of resilience is pivotal when discussing the potential effects of disturbance on a landscape. However, there are several ways of defining resilience (Folke 2006). (Holling 1973) described two behaviors of ecological systems: stability, “the ability of a system to return to an equilibrium state after a temporary disturbance” where higher stability equates to fewer fluctuations and a quicker return to an equilibrium state; and resilience, “a measure of the persistence of systems and of their ability to absorb change and disturbance and still maintain the same relationships between populations or state variables.” By these definitions, a system might have low stability and high resilience, if it is able to persist through extensive or frequent disturbances. (Westman 1978) built on the concept of resilience and defined five characteristics of resilience:

- Inertia: the resistance of a system to change
- Elasticity: how quickly a system would return to a pre-disturbance state
- Amplitude: the threshold beyond which a system would not return to a pre-disturbance state
- Hysteresis: how dissimilar the paths and processes are between system alteration and recovery
- Malleability: how similar the post-disturbance stable state is to the pre-disturbance stable state (for example, the difference between pre- and post-disturbance climax conditions)

Changes in disturbance regimes can lead to changes in system structure and functionality, crossing the "amplitude" into a new state. The new system may also be resilient, but differ from the prior system and would not return without some perturbation not intrinsic to the new system. This idea that systems can change from one self-reinforcing regime to another is referred to as "alternative stable states." Changes in state are often portrayed as a "ball-in-cup" diagram, where a ball would stay within its cup for some perturbations, but a larger perturbation would send the ball into another cup. If a system has high hysteresis and a perturbation changes it to a new stable state, an equal but opposite perturbation would not shift it back to its original state (Beisner et al. 2003) (Figure 2).

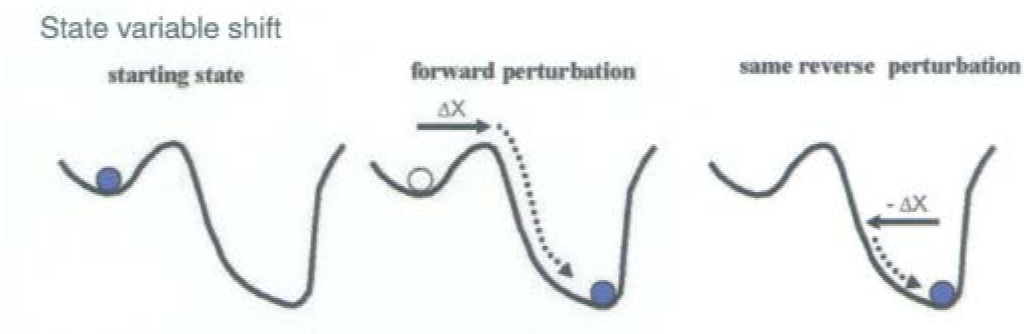

Figure 2: Stability and hysteresis. At left, a system may be able to handle small perturbations, but a larger one, ΔX, moves the system into a new stable state. An equal and opposite perturbation does not return the system back to the original state. (Figure from Beisner et al. 2003.)

Changes in disturbance regimes such as fire suppression and past management, differences in land use based on ownership (ie. public/private, industrial/non-industrial forestry, agriculture and development), as well as the introduction of exotic invasive species, mean that in many areas of the forest are at risk of changing to a new stable state without active management. Some areas may have already transitioned to a new stable state that would be difficult or impossible to reverse. The context of climate change would also affect the resilience of forest ecosystems, and would likely create novel systems.

Resilience is scale-dependent, both spatially and temporally. A given organism or stand may not be resilient, but the landscape may be resilient if it can maintain or return to the same structure and functionality after a disturbance. In a mixed-severity fire regime, a fire disturbance might result in stands burned at low, moderate, and high severity. Any given stand may not be resilient, but the landscape as a whole may be resilient when viewed over decades or centuries (Stine et al. 2014). Note that a system may be resilient yet may not be in a desirable state (Folke 2006). For example, meadows dominated by exotic annual invasive grasses cheatgrass (*Bromus tectorum*) may be highly resilient to fire disturbance and, to the frustration of land managers, resilient to restoration efforts (Brooks et al. 2004).

Quantifying resilience is challenging, based not only on the fact that the above characteristics are often difficult to measure (Carpenter et al. 2001, Westman 1978), but because the time scale on which resilience must be measured on long time scales (hundreds to thousands of years, rather than decades) (Folke 2006). Ecosystem modeling and adaptive management are critical tools for assessing the impacts of restoration activities, so that land managers can estimate potential impacts before implementation, and track results over the long term (Stine et al. 2014).

In addition to changes in disturbance regimes and past management, land ownership and changes in land type and land use would complicate restoration efforts. The Forsythe II Project area is fragmented with a variety of landholdings (ie. NFS lands, Boulder County lands, and private inholdings) where it may be impossible to restore anything similar to historical disturbance regimes. We may not be able to manage for historical disturbance regimes within the wildland urban interface, where life and property must be protected. Some areas have experienced permanent changes in land use, such as in locations of private residences, towns, and reservoirs.

Landscape

In order to restore system resilience, managers need to consider biophysical setting of the landscape, and the scales appropriate for relevant disturbance agents. The biophysical setting is the combination of vegetation, topography, climate, and geology unique to an area. There are multiple biophysical settings within a landscape. These settings interact with each other and may change the behavior of disturbances. Landscape scales should be large enough to encompass the largest disturbance event that might occur in a given area based on its biophysical settings and disturbance regime. Within a landscape, a given stand may not be resilient, but if the landscape can return to its prior method of function post-disturbance the landscape as a whole would be resilient. Treatments should aim to promote resilience at the landscape scale, not merely at the stand scale. An ecological sub-region is a collection of landscapes with similar disturbance processes and biophysical settings (Stine et al. 2014).

Climate Change

Average global temperatures are increasing due to increases in greenhouse gasses. In Colorado, temperatures have been rising, especially in summer, and that trend is expected to continue, along with increases in the frequency and intensity of heat waves, droughts and wildfire (Gordon et al 2015). Fires have become larger and more severe in recent decades, and these trends are projected to continue due to hydrologic changes and longer wildfire seasons (Westerling et al. 2006).

Compounded effects of “hotter droughts” and moisture stress would continue to lead to increased vulnerability to insect and disease attack, and uncharacteristically large and/or severe fire disturbances (Millar and Stephenson 2015). Management approaches should consider actions to reduce water competition, and to allow ecosystems to be resilient to current and projected future disturbance regimes and climate extremes while maintaining as many ecosystem services as possible (Millar and Stephenson 2015).

Established species may be maladapted to future conditions. Maladaption may be due to phenologic shifts (earlier onset of budbreak, blooming, longer growing season) (Stine et al. 2014) and mismatches with pollinators (Hegland et al. 2009) or herbivores (Fabina et al. 2010). Species with small, highly dispersed populations; low genetic diversity; or species at the end of their range with no suitable adjacent habitat (such as high-elevation species) would be most vulnerable to climate change. Seeds from long-lived species may not provide enough genetic diversity to maintain pace with climate changes (Erickson et al. 2012). Even species with wide distributions may be of concern.

Climate change would provide additional stresses on forests. These stresses would combine with the legacies of past management that have simplified age structures or favored single-species stands over broad areas to exacerbate many forest health issues (Seidl et al 2011, O’Hara 2014). O’Hara continues on to say that “management responses to these threats should be to encourage species diversity as well as assist the dispersal of species to more appropriate climates.”

Though there are concerns about the methodologies for many species climate-envelope studies (Loehle 2011), shifts in latitude and elevation for tree seedlings due to climate change appear to be occurring already (Monleon 2015). Key components for managing systems in the context of climate change would include maintaining genetic diversity of populations, planting with stocks outside of current established seed zones and elevation bands, plant seedlings bred for disease and pest resistance (potentially creating opening specifically for this purpose). In extreme cases where species are at the end of their range and there is “no place to go” (e.g. high-elevation species) assisted migration would occur. Also, changes in climate would lead to unique and currently unseen species assemblages that may have unpredictable dynamics or relationships to pests and pathogens. Monitoring would be critical in current and future management efforts (Erickson et al. 2012).

Lodgepole pine

In the lodgepole pine dominated stands generally found at the higher elevation end of the Upper Montane Zone of the project area, patches of various structural stages of lodgepole pine stands would be distributed across the area. A mosaic of individual stands adjacent to other lodgepole pine dominated stands with a different vertical structure, would provide a greater resilience to multiple disturbances.

Stands are composed of roughly even-aged vegetation groups, varying in size, species composition, and structure. Individual vegetation groups range from less than 0.5 to more than 20 acres in size. Tree sizes would range from seedlings to very large diameter trees. Species composition would vary by elevation, site productivity, and related environmental factors. Some patches would have mixed conifer species and aspen associated with the dominant lodgepole pine stand.

In lodgepole pine regeneration patches resulting from both past artificial and natural disturbances, tree densities would be reduced beginning at the sapling stage with continued tree density reductions over time as the trees mature.

Ponderosa pine/Mixed conifer

The Forest Plan emphasizes the management of ponderosa pine to emulate conditions representative of a nonlethal understory fire regime. The Plan further directs the restoration of natural processes through human-induced activities. These activities could include prescribed fire or mechanical treatments of vegetation to improve wildlife habitats, restore forest health, assist in the recruitment of old-growth ponderosa pine, reduce fuel loading and maintain or restore ecological conditions.

On low- to mid-elevation sites and on hotter, drier, south slopes, sites would be dominated with ponderosa pine. The desired stand condition would be a mosaic of trees with both horizontal and vertical structure. Conifers within these stands would be unevenly spaced across the area, sometimes in small groups with enough space between individual trees or groups of trees so that the crowns of the trees are not continuously intermingled.). Restoration of these forests typically aims to increase canopy cover heterogeneity to emulate forest structures created by historical mixed-severity fire regimes by creating patchy forest cover with large openings, groups of trees, and isolated trees within each treatment unit (Dickinson et al. 2014, Larson & Churchill 2012, Clement & Brown 2011, Covington & Moore 1994).

In mixed conifer stands, multi-tiered canopies, particularly in older forests, provide vertical heterogeneity. Dead trees, both standing and fallen, meet habitat needs of old-forest associated species. Where possible, areas treated for fuels levels also provide for the successful establishment of early seral stage vegetation.

Historically, openings were prevalent on south- and east- facing aspects, at lower elevations, and on gentler slopes. The findings of Dickinson’s study indicate that forest managers restoring montane ponderosa forests on the Colorado Front Range should increase the abundance of openings through silvicultural treatments, focusing particularly on increasing the abundance of small openings (<50m long) by breaking down large contiguous patches (<50 m long) into smaller patches (<50m long) (Dickinson 2014).

In the lower montane, recreating a mosaic of open and forested conditions is increasingly recognized as a restoration objective in formerly fire-dependent conifer forests that have been homogenized by intensive management and/or fire suppression (Dickenson et al. 2016).

Mixed conifer stands include a species mix of ponderosa pine, Douglas-fir, limber pine, lodgepole pine, and aspen. Unit prescriptions in mixed conifer stands would be designed to mimic historic fire regimes and achieve desired spatial patterns representative of the vegetation type. Treatment prescriptions would utilize a variation of the individuals, clumps, and openings (ICO) approach and variable density thinning to restore the spatial pattern (Churchill et al. 2013). This approach would create clumps of trees (groups of conifers with interlocking crowns), individual trees, and openings between residual trees to address visual, ecological, or social concerns. Scientifically, there is a broad consensus that to increase resilience, treatments should seek to restore the range of patterns found in forests with intact disturbance regimes (Churchill et al. 2014, Covington et al. 1997, Allen et al. 2002, North et al. 2009, Stephens et al. 2010, Franklin and Johnson 2012).

Douglas-fir/Mixed conifer
At increasing elevation in the montane zone, the density of ponderosa pine-dominated stands increases, and on more mesic sites at higher elevations and/or on north-facing aspects it co-occurs with Douglas-fir or mixed conifer cover types (Veblen and Donnegan 2005). Stands on cool, moist, north slopes would be predominately ponderosa pine and Douglas-fir with a mixture of other conifer species and aspen. These stands would be denser than stands on south slopes due to aspect and higher moisture levels.

Where Douglas-fir and ponderosa pine co-occur in the same stand and on aspects favorable for moisture conditions, there is a tendency for the Douglas-fir to slowly, successionally replace the pine. In the mid-montane to lower montane stands, ponderosa pine would have a greater representation in all size classes in these mixed ponderosa pine/Douglas-fir stands as compared to the existing condition. In the montane zone, there is much variability of successional pathways due to spatial heterogeneity related mainly to topography (Peet 2000).

Quaking Aspen
With increased forest density and the exclusion of fire, the populations and aggregations of pioneer tree species like aspen have been reduced. The ARNF Forest Plan provides direction to encourage the growth and expansion of aspen clones. This would increase the landscape heterogeneity and complexity and provide a greater variety of environments and increased diversity.

Aspen stands would show a range of stand structures reflective of disturbance patterns; even-aged, mixed-age, and mosaics of both may be common where relatively pure stands abut conifer and aspen-mixed conifer forests (Rogers et al. 2014).Young aspen clones would be encouraged and a greater component on the landscape because they become an under-represented feature in the absence of disturbance. Aspen stand structure would be variable with an emphasis of pure clones to reset successional processes of conifer invasion within the clones perimeters.

Meadows and Shrublands
Existing meadows and grasslands would continue to be a key component of the landscape and contribute to its heterogeneity and diversity that it can provide. These features may be located throughout, but they would be generally found on southerly exposures, on steeper slopes and vary in size and arrangement to other landscape features. Larger meadows and grasslands would play an important role for wildlife and also influence disturbance processes such as crown-fire, insects, and disease.

Old Growth and Old Growth Development

Across the project area, there are ponderosa pine and Douglas-fir stands classified as old growth. These stands can occur as inventoried old growth, retention old growth, or old growth development as described in the Forest Plan. Old growth was recognized as a unique forest structural stage prior to 1990 on the ARP (Lowry 1992). The Forest identified and inventoried existing and future old growth stands based on characteristics unique to each dominant vegetation type. As a minimum rule, large live trees, some of which were old and declining, either snags or fallen trees, and greater than 20 percent overhead canopy closure were all prerequisites for a site to be called old growth (Lowry 1992).

The desired condition for old growth stands that is identified in the Forest Plan emphasizes old growth recruitment and retention. Old growth stands would have the presence of a population of old trees and their associated structures (i.e. dead trees, tree canopy gaps, large downed woody material). On a landscape scale, it is desirable to re-create the historical mosaic of forest age and size structure, including sizeable openings. In order to maintain old growth on the landscape, management may be needed in less than optimal locations to ensure that this habitat type is maintained on the landscape while other areas grow into old growth through the process of succession.

Old growth development designated stands would continue to mature and develop the characteristics of old growth within the next century. The percentage of old growth and their associated structures would increase across the landscape. (Huckaby et al, 2003) concluded that regardless of how restoration is accomplished, old trees would benefit from a reduction of forest density in the montane zone of the Front Range. Therefore, some old growth stands would have lower densities while still favoring old growth characteristics.

Defensible Space

The desired condition for defensible space treatment area would be a vegetative structural arrangement both horizontally and vertically that is in compliance with the Colorado State Forest Service defensible space guidelines. The species composition at each location would dictate the desired vegetation arrangement so that the structure on private land is more defensible in a stand replacing wildfire event. In lodgepole pine dominated stands, trees would generally be grouped and spaced in order to minimize crown fire spread while maintaining windfirmness during high wind events. In both ponderosa and Douglas-fir /Mixed conifer stands, trees would be spaced as individual trees or in groups of trees in order to minimize crown fire spread. A mixture of conifer species would be represented favoring ponderosa pine over other tree species. Conifers would be free of branches up to 10 feet from ground level. Conifers less than 10 feet tall, would not have branches up to the point where there is at least 30% live crown. Ladder fuels would be virtually non-existent in all situations. Aspen clones would be conifer free with the exception of ponderosa pine greater than 16” DBH, which would remain.

Environmental Consequences

The Forsythe II Project proposed action would treat vegetation using a variety of methods across the 18,954 acres within the analysis area. See Appendix B for specific proposed vegetation treatment activities within each unit for each of the action alternative. Fuels would be treated on some of the acres, and the effects would be discussed in the project fuels report (see fuels specialist report).

The treatment prescriptions for each unit are based on a combination of vegetation type, slope and location, as well as other site specific considerations. Mechanical fuels treatment may occur on slopes up to 30% (slopes up to 40% may be considered on a site specific basis) as analyzed in the Forsythe II EA, and would generally consist of whole tree cutting and tractor piling as well as some prescribed fire. Units would be pre-marked according to a specific prescription in order to meet project objectives.

The comparison of alternatives are depicted in tables throughout this section to show how the management indicators compare with each other under the different alternatives. This section provides further information about the environmental consequences of each alternative. The No Action Alternative is not included in the tables because vegetation treatments would not be implemented.

Table 6 - Comparison of proposed treatment acres by each action alternative.

Treatment	Alternative 1 Proposed Action	Alternative 2	Alternative 3	Alternative 4
Mixed Conifer Old Growth Treatment	42	8	42	42
2-Staged Mixed Conifer Treatment	44	44	n/a	44
Douglas-fir Mixed Conifer Treatment	971	796	885	971
Ponderosa Pine Mixed Conifer Treatment	392	293	370	392
Thin from Below	n/a	n/a	61	n/a
Lodgepole Pine Treatment	741	308	383	445
Regeneration Thin	17	8	17	17
Aspen Restoration	231	163	255	231
Meadow/Shrubland Restoration	45	37	32	45
Broadcast Burn	968	968	968	968
Total Treatment Acres	**3,151**[1]	**2,325**[2]	**2,713**[3]	**2,855**[4]
Defensible Space	203	286	220	88

[1] Total Treatment Acres excludes the 300 acres that would receive a combination of mechanical/hand treatment and broadcast burning so as not to count those acres twice.
[2] Total Treatment Acres excludes the 290 acres that would receive a combination of mechanical/hand treatment and broadcast burning so as not to count those acres twice.
[3] Total Treatment Acres excludes the 297 acres that would receive a combination of mechanical/hand treatment and broadcast burning so as not to count those acres twice.
[4] Total Treatment Acres excludes the 300 acres that would receive a combination of mechanical/hand treatment and broadcast burning so as not to count those acres twice.

No Action Alternative

This is the no action alternative. Under this alternative there would be no new projects or actions taken at this time through this analysis. General forest management activities such as fire suppression, minor road and trail maintenance, recreation and personal use fuelwood cutting would continue as authorized. The currently available developed and dispersed recreation sites and trails would remain open. Changes may occur from wildfire or mortality due to insects, disease or other natural events.

Additional stand and fuels management activities, including thinning of stands, patchcuts, clearcuts, aspen restoration, meadows/shrublands restoration and subsequent prescribed burning activities would be deferred. The “no action” alternative would defer the proposed action, but continue current uses within the Forsythe II analysis area.

No Action Alternative - Direct and Indirect Effects

Under the no action alternative there would not be any management activities pursued. Therefore, there would be no direct effects as a result of management activities. However, the course of no action is not without effects. An indirect effect of no action would be that vegetation would continue to grow, and subsequent fuel loading would continue to accumulate. Water stress would continue to increase as vegetation and forest stands continue to accumulate more biomass. More biomass would require more water to remain viable (Grant et al 2013). Climate change is an unknown factor in assessing potential outcomes. It is assumed that the current trends would continue in the short term time frame, and so this indicates that water (drought) stress would continue to be a contributing factor in vegetation stressors.

Crown canopy cover reduction would not occur as a management action, as a result of the no action alternative, but may be an indirect consequence of no action. Endemic insect and disease activity would continue to occur, and may increase as density levels continue to increase. A consequence of no action would be that stand densities would increase through time and critical thresholds for beetles would eventually be reached (Fettig et al 2007, Oliver 1995). If this situation were to occur, the dead trees would eventually contribute to dead fuel loading. As insects and disease issues become more numerous, stand conditions would further deteriorate and cause individual tree mortality. In homogeneous stands of the same species, endemic levels may become epidemic. Epidemic occurrences of insects (specifically bark beetles) would cause higher canopy cover reductions.

Generally, the no action alternative would result in increased canopy cover in the short term time frame. In the long term time frame, it is not known what the canopy would be but as trees continue to grow and stand density increases, the canopy would eventually decline. It is likely that larger, more dominant trees would die as they are more susceptible to bark beetles (Oliver 1995). The loss of overstory trees would reduce canopy cover more significantly than thinning of small and medium sized trees, as those trees contribute less to overall canopy cover. The larger trees, due to their dominant crown position generally occupy more crown canopy cover than smaller, intermediate trees.

Demands for ecosystem services provided by the project area would continue to exist, and a course of no action may compromise the landscape so that it cannot deliver services in the long- term time frame. Forest cover loss may occur from insects, disease or wildland fire at some point in the future. The choice of no action results in a higher risk to stand replacing events over time. The project area has significant demands for water and recreation. There are drinking water demands from Gross Reservoir; the project area provides much of the water resources that contribute to the reservoir. Loss of forest cover would result in a changed hydrologic regime, and is dependent on the scale of change.

Vegetation would continue to grow over time, and successional pathways that are already limited due to lack of an active disturbance regime would become more limited. As these limits are reached, vegetation would die and this would result in a net increase of fuel loading. It is likely that the larger trees, which require more site resources would become the most ‘at risk’ of loss due to crowed conditions. The mature, overstory trees are often successfully attacked during bark beetle outbreaks (Oliver 1995), and density thresholds would remain at and above zones where enough site resources exist to provide for stand level health. Growth would also be less, and so the cumulative effect of crowded conditions is that stands remain in a stagnant state.

There would be no means to effectively provide for ‘old forest conditions’ without active management (analogous to an active disturbance regime). Essentially, the growth system of the plant community is closed and would remain this way until some type of event disrupts the cycle. Historically, a disruption in this type of vegetation had been realized in wildfires or insect outbreaks that resulted in a mosaic of stand variation across the landscape adding to the 'old forest condition' arrangement.

Over time and a changing climate, old growth ponderosa pine and associated stands could lose a majority of the large tree component. In the absence of a disturbance and as the younger trees grow, competition for moisture and other resources would increase resulting in the suppression mortality of the smaller stems and gradual loss of the larger trees. Bark beetles would be the main contributor to the large tree mortality as stress makes larger trees more susceptible to successful insect attack. Old growth status for lodgepole pine is short-lived, and lodgepole old growth would decline at a faster rate than ponderosa pine old growth.

Seral stage aspen communities would continue to decline over time as they are disturbance dependent. No action scenario would not provide for disturbance systems to actively work within the aspen communities, and would rely on environmental factors to continue to determine outcomes. The existing condition of aspen communities shows that conifer encroachment would continue, which would lead to continued decline of individual aspen and overall reduction of clonal viability. Wildland fires, if they were to occur in the aspen communities would be suppressed. The lack of fire, as well as competing conifers indicates that the seral aspen communities in Forsythe II Project area could be entirely lost.

Conifer encroachment would continue to invade meadow and shrubland systems, and would result in a reduction of herbaceous plant communities over time. Loss that is currently documented would continue to occur, and may be increased. Current encroachment has allowed conifers to grow into meadow systems, which effectively provides more conifer seed source to the internal meadow. With more conifers present within and adjacent to the meadow, the water balance would be also changed. Changed water amounts may create changes to plant communities.

Continued absence of active management would further decrease meadow size now and in the long term time frame. Meadow systems exist as a result of disturbance regimes acting within the ecosystem. Lack of disturbance would result in further conifer encroachment, and eventual conifer domination. Soil types would be changed so that meadow soils would no longer be present in the long-term time frame.

With unknown effects from climate change and drought cycles, the effects of catastrophic disturbances may occur at any point in the future. There is a high level of uncertainty related to water and climate trends; less moisture is likely to result in increased risk to all catastrophic events. The choice of no action is likely to leave the project area at higher risk to a catastrophic event (or combination of events).

Alternative 1 – Proposed Action

Alternative 1 would treat approximately 3,151 acres of the 9,930 acres of NFS lands within the project area. The proposed action includes 2,483 acres of mechanical/hand treatment and 968 acres of broadcast burning. A combination of mechanical/hand treatment and broadcast burning would occur on 300 acres. Additionally, 2,032 acres are analyzed for defensible space to provide permitted homeowners adjacent to NFS lands the ability to treat on NFS lands. However, it is estimated that up to 10% of the analyzed defensible space acres would be treated, or 203 acres. Proposed management activities include thinning 1,449 acres of mixed conifer stands, patchcutting/ clearcutting 741 acres of lodgepole pine stands, thinning 17 acres of regenerated lodgepole pine stands, cutting 276 acres of conifers within aspen and meadows/shrublands areas. See the description of treatments for this alternative in Appendix B.

Reforestation treatments (tree planting of mixed conifer species) would occur in patchcuts/ clearcuts. Timber stand improvement (thinning) would continue every 7-15 years, or as needed into the future, and done manually. Approximately 7 miles of temporary roads would be constructed to facilitate the vegetation management activities and would be decommissioned after the completion of treatment activities.

The methods to treat vegetation and fuels include mechanical and hand thinning, fuels piling and burning, and broadcast burning. These methods are uniquely prescribed to each delineated polygon based on vegetation and fuels conditions that have been observed and documented. The treatment proposals consider integrated objectives and ecological restoration across landscapes. Various treatment combinations would be pursued across the project area, and are further detailed and described in appendices to this report.

The Boulder Ranger District utilized input received during the project scoping, from the public as well as input from internal U.S. Forest Service resource specialists, to develop this detailed proposed action. The proposed action uses the dominant vegetation stand conditions that occur across the project area to delineate proposed treatment units (see project map). The dominant vegetation stand conditions include mixed conifer stands, lodgepole pine stands, aspen stands, and meadows/shrublands. There are conditions that occur across the project area where a management unit might be delineated as a mixed conifer stand but contain aggregations (1/2 acre to 5 acres in size) of the other dominant stand conditions. These aggregations could be expected to occur across 30% of any given unit and across more than 50% of the proposed units. As an example, in a unit designated as mixed conifer there may be areas within the unit that have aspen clones, meadows, or patches of lodgepole pine. In situations where aggregations occur across a unit, the appropriate treatment would be implemented as described below.

To achieve the goals of a resilient forest, proposed activities would maintain stand densities at levels appropriate for the site (Reineke 1933; Long and Shaw 2005). Topography, slope, aspect and elevation would be factored into each treatment (North et al 2009). Project design would incorporate important features including riparian areas and corridors, openings, aspen stands, and open and closed forests (Addington et al. Draft). Sustainable patches of mixed conifer species would be represented on north and west aspects. Reforestation treatments (tree planting of mixed conifer species) would occur in patchcuts and clearcuts of previously lodgepole pine dominated stands to promote a diverse forest in the face of a changing climate (Kaufmann et al. 2012). Forested stands with high stand structural diversity would correspond to a greater and richer flora and fauna in all vegetation types across the landscape (O'Hara, 2014).

Management actions that promote the objectives described below, and result in a more diverse landscape, would lessen impacts of future disturbances such as wildfire within the watershed. Acres were derived by Geographical Information System (GIS) query and are referred to as mapped acres in this document. Exact acreage treated is verified on the ground prior to implementation. The Proposed Action Design Criteria provides additional detail to the management activities described below.

Appendix B details each proposed treatment method within each uniquely identified treatment polygon (Unique ID). The proposed treatments may affect the same acres more than once. The effects analysis in this report shows the anticipated effects on each acre based on the treatment proposal that is part of these alternatives and so outputs that are reported account for each distinct treatment entry. For example, a unit that is mechanically thinned may then be piled, with subsequent pile burning and/or a broadcast burn treatment. The type of treatment, unit identifiers and associated areas are identified in the table below. More information about each proposed treatment can be found in Appendix B.

Table 7 - Proposed prescriptions and treatments within the Forsythe II project area for Alternative 1. A combination of treatments may be utilized within each stand (Unique ID), resulting in the same acres being

treated by more than one method. Appendix B shows the combination of proposed treatment types by Unit ID.

Treatment Type	Unit Numbers	Total Acres
Lodgepole Pine Treatment	1-4, 10, 11, 14, 16, 17, 19, 21-24, 26-31, 33, 42, 58, 75, 76, 101, 103, 107	741
Ponderosa pine / Mixed Conifer Treatment	37, 46, 48-52, 63, 69, 73, 104, 105	392
Douglas-fir / Mixed Conifer Treatment	9, 12, 39, 40, 43, 45, 47, 55, 57, 59, 60, 68, 72, 77, 78, 80	971
Mixed Conifer Treatment – Old Growth	54, 79	42
Aspen Restoration	5, 7, 8, 15, 20, 32, 53, 56, 61, 62, 67, 81, 102, 106	231
Meadow/Shrubland Restoration	18, 41	45
2-Staged Mixed Conifer Treatment	74	44
Regeneration Thin	82-100	17
Thin From Below	n/a	n/a
Broadcast Burn	38, 39, 40, 41, 42, 44, 45, 46, 48	*968
Private Home Defensible Space		**2,032
	TOTAL ACRES	3,151

*Both mechanical/manual treatment and broadcast burning would occur on 300 acres.

**Analyzed for acreage, but it is estimated that only 10% or less would be treated.

Alternative 2

The ID team developed Alternative 2 to address wildlife, soils, and hydrology concerns while still meeting the purpose and need for this project as described in Chapter 1 of this document. Alternative 2, when compared to Alternative 1 – Proposed Action, limits the size of clearcuts to 10 acres, allows cutting trees up to 14 inch DBH, increases the amount of basal area or volume cut within ponderosa pine mixed conifer treatment units to 50%, and allows up to 30% of any given lodgepole pine treatment unit to be cut.

Alternative 2 would treat approximately 2,334 acres of the 9,930 acres of NFS lands within the project area. The proposed action includes 1,657 acres of mechanical/hand treatment and 968 acres of broadcast burning. A combination of mechanical/hand treatment and broadcast burning would occur on 291 acres. Additionally, 2,862 acres are analyzed for defensible space to provide permitted homeowners adjacent to

NFS lands the ability to treat on NFS lands. However, it is estimated that up to 10% of the analyzed defensible space acres would be treated, or 286 acres. See the description of treatments for this alternative in Appendix B.

Proposed management activities include thinning 796 acres of Douglas-fir dominated mixed conifer stands, thinning 293 acres of ponderosa pine dominated mixed conifer stands, patchcutting/clearcutting 308 acres of lodgepole pine stands, thinning 8 acres of regenerated lodgepole pine stands, cutting 200 acres of conifers within aspen and meadows/shrublands areas, and broadcast burning 968 acres. Reforestation treatments (tree planting of mixed conifer species) would occur in patchcuts/clearcuts. Thinning lodgepole pine regeneration in the areas patchcut/clearcut under this decision would continue every 7-15 years, or as needed into the future, and done manually. Approximately 7 miles of temporary roads would be constructed to facilitate the vegetation management activities and would be decommissioned after the completion of treatment activities.

The dominant vegetation stand conditions that occur across the project area were used to delineate proposed treatment units. The dominant vegetation stand conditions include mixed conifer stands, lodgepole pine stands, aspen stands, and meadows/shrublands. There are conditions that occur across the project area where a management unit might be delineated as a mixed conifer stand but contain aggregations (1/2 acre to 5 acres in size) of the other dominant stand conditions. These aggregations could be expected to occur across 30% of any given unit and across more than 50% of the proposed units. As an example, in a unit designated as mixed conifer there may be areas within the unit that have aspen clones, meadows, or patches of lodgepole pine. In situations where aggregations occur across a unit, the appropriate treatment would be implemented as described below.

Table 8 - Proposed prescriptions and treatments within the Forsythe II project area for Alternative 2. A combination of treatments may be utilized within each stand (Unique ID), resulting in the same acres being treated by more than one method. Appendix B shows the combination of proposed treatment types by Unit ID.

Treatment Type	Unit Numbers	Total Acres
Lodgepole Pine Treatment	1-4, 10, 11, 14, 16, 17, 19, 21-24, 26-31, 42, 58, 75, 76, 101, 103, 107	308
Ponderosa pine / Mixed Conifer Treatment	46, 48, 49, 51, 52, 63, 73, 104, 105	293
Douglas-fir / Mixed Conifer Treatment	9, 12, 39, 40, 43, 45, 47, 55, 59, 68, 77, 80	796
Mixed Conifer Treatment – Old Growth	54	8
Aspen Restoration	5, 7, 8, 15, 20, 53, 61, 67, 81, 102, 106	163
Meadow/Shrubland Restoration	18, 41	37
2-Staged Mixed Conifer Treatment	74	44

Regeneration Thin	82, 83, 86, 89, 90, 92-94, 96-100	8
Thin From Below	n/a	n/a
Broadcast Burn	38, 39, 40, 41, 42, 44, 45, 46, 48	*968
Private Home Defensible Space		**2,860
	TOTAL ACRES	2,334

*Both mechanical/manual treatment and broadcast burning would occur on 300 acres.

**Analyzed for acreage, but it is estimated that only 10% or less would be treated.

Alternative 3

The ID team developed Alternative 3 to address wildlife, soils, and hydrology concerns while still meeting the purpose and need for this project as described in Chapter 1 of this document. For Alternative 3, when compared to Alternative 1 – Proposed Action, 15 units were dropped and another 10 units became smaller units. These changes decreased the treatment acres by 438 acres, however another five units were added, 88 acres, to address public comments received.

Alternative 3 would treat approximately 2,717 acres of the 9,930 acres of NFS lands within the project area. The proposed action includes 2,045 acres of mechanical/hand treatment and 968 acres of broadcast burning. A combination of mechanical/hand treatment and broadcast burning would occur on 296 acres. Additionally, 2,200 acres are analyzed for defensible space to provide permitted homeowners adjacent to NFS lands the ability to treat on NFS lands. However, it is estimated that up to 10% of the analyzed defensible space acres would be treated, or 220 acres. See the description of treatments for this alternative in Appendix B.

Proposed management activities include thinning 885 acres of Douglas-fir dominated mixed conifer stands, thinning 370 acres of ponderosa pine mixed conifer stands, patchcutting/clearcutting 383 acres of lodgepole pine stands, thinning 17 acres of regenerated lodgepole pine stands, cutting 287 acres of conifers within aspen and meadows/shrublands areas, and broadcast burning 968 acres. Reforestation treatments (tree planting of mixed conifer species) would occur in patchcuts/clearcuts. Thinning lodgepole pine regeneration in the areas patchcut/clearcut under this decision would continue every 7-15 years, or as needed into the future, and done manually. Approximately 5 miles of temporary roads would be constructed to facilitate the vegetation management activities and would be decommissioned after the completion of treatment activities.

The dominant vegetation stand conditions that occur across the project area were used to delineate proposed treatment units. The dominant vegetation stand conditions include mixed conifer stands, lodgepole pine stands, aspen stands, and meadows/shrublands. There are conditions that occur across the project area where a management unit might be delineated as a mixed conifer stand but contain aggregations (1/2 acre to 5 acres in size) of the other dominant stand conditions. These aggregations could be expected to occur across 30% of any given unit and across more than 50% of the proposed units. As an example, in a unit designated as mixed conifer there may be areas within the unit that have aspen clones, meadows, or patches of lodgepole pine. In situations where aggregations occur across a unit, the appropriate treatment would be implemented as described below.

Table 9 - Proposed prescriptions and treatments within the Forsythe II project area for Alternative 3. A combination of treatments may be utilized within each stand (Unique ID), resulting in the same acres being treated by more than one method. Appendix B shows the combination of proposed treatment types by Unit ID.

Treatment Type	Unit Numbers	Total Acres
Lodgepole Pine Treatment	1-4, 14, 16, 22-24, 26-28, 30, 31, 33, 58, 75, 101, 103, 107	383
Ponderosa pine / Mixed Conifer Treatment	37, 46, 48, 49, 50, 51, 52, 63, 69, 73, 104, 105	370
Douglas-fir / Mixed Conifer Treatment	9, 39, 40, 43, 45, 47, 55, 72. 77, 78, 80	885
Mixed Conifer Treatment – Old Growth	54, 79	42
Aspen Restoration	5, 7, 8, 15, 20, 32, 53, 56, 61, 62, 67, 81, 102, 106, 110-112	255
Meadow/Shrubland Restoration	41, 108	32
2-Staged Mixed Conifer Treatment	n/a	n/a
Regeneration Thin	82-100	17
Thin From Below	109	61
Broadcast Burn	38, 39, 40, 41, 42, 44, 45, 46, 48	*968
Private Home Defensible Space		**2200
	TOTAL ACRES	2,717

*Both mechanical/manual treatment and broadcast burning would occur on 300 acres.

**Analyzed for acreage, but it is estimated that only 10% or less would be treated.

Alternative 4

The ID team developed Alternative 4 to address wildlife, soils, and hydrology concerns as well as public comments received during the scoping period while still meeting the purpose and need for this project as described in Chapter 1 of this document. Alternative 4 differs from Alternative 1 – Proposed Action, because the treatments would be done manually except in areas mapped as lodgepole pine treatment and the diameter cut limit would be 12 inches DBH. The lodgepole pine treatment could be completed either mechanically or manually, only patchcuts up to five acres in size would be allowed, and up to 30% of any given unit could be cut.

Alternative 4 would treat approximately 2,855 acres of the 9,930 acres of NFS lands within the project area. The proposed action includes 2,187 acres of mechanical/hand treatment and 968 acres of broadcast burning. A combination of mechanical/hand treatment and broadcast burning would occur on 300 acres. Additionally, 878 acres are analyzed for defensible space to provide permitted homeowners adjacent to NFS lands the ability to treat on NFS lands. However, it is estimated that up to 10% of the analyzed defensible space acres would be treated, or 88 acres. See the description of treatments for this alternative in Appendix B.

Proposed management activities include thinning 971 acres of Douglas-fir dominated mixed conifer stands, 392 acres of ponderosa pine dominated mixed conifer stands, patchcutting 445 acres of lodgepole pine stands, thinning 17 acres of regenerated lodgepole pine stands, cutting 276 acres of conifers within aspen and meadows/shrublands areas, and broadcast burning 968 acres. Reforestation treatments (tree planting of mixed conifer species) would occur in patchcuts. Thinning lodgepole pine regeneration in the areas patchcut under this decision would continue every 7-15 years, or as needed into the future, and done manually. Approximately 5 miles of temporary roads would be constructed to facilitate the vegetation management activities and would be decommissioned after the completion of treatment activities.

The dominant vegetation stand conditions that occur across the project area were used to delineate proposed treatment units. The dominant vegetation stand conditions include mixed conifer stands, lodgepole pine stands, aspen stands, and meadows/shrublands. There are conditions that occur across the project area where a management unit might be delineated as a mixed conifer stand but contain aggregations (1/2 acre to 5 acres in size) of the other dominant stand conditions. These aggregations could be expected to occur across 30% of any given unit and across more than 50% of the proposed units. As an example, in a unit designated as mixed conifer there may be areas within the unit that have aspen clones, meadows, or patches of lodgepole pine. In situations where aggregations occur across a unit, the appropriate treatment would be implemented as described below.

Table 10 - Proposed prescriptions and treatments within the Forsythe II project area for Alternative 4. A combination of treatments may be utilized within each stand (Unique ID), resulting in the same acres being treated by more than one method. Appendix B shows the combination of proposed treatment types by Unit ID.

Treatment Type	Unit Numbers	Total Acres
Lodgepole Pine Treatment	1-4, 10, 11, 14, 16, 17, 19, 21-24, 26-31, 33, 42, 58, 75, 76, 101, 103, 107	445
Ponderosa pine / Mixed Conifer Treatment	37, 46, 48- 52, 63, 69, 73, 104, 105	392
Douglas-fir / Mixed Conifer Treatment	9, 12, 39, 40, 43, 45, 47, 55, 57, 59, 60, 68, 72, 77, 78, 80	971
Mixed Conifer Treatment – Old Growth	54, 79	42
Aspen Restoration	5, 7, 8, 15, 20, 32, 53, 56, 61, 62, 67, 81, 102, 106	231
Meadow/Shrubland Restoration	18, 41	45

2-Staged Mixed Conifer Treatment	74	44
Regeneration Thin	82-100	17
Thin From Below	n/a	n/a
Broadcast Burn	38, 39, 40, 41, 42, 44, 45, 46, 48	*968
Private Home Defensible Space		**880
	TOTAL ACRES	2,855

*Both mechanical/manual treatment and broadcast burning would occur on 300 acres.

**Analyzed for acreage, but it is estimated that only 10% or less would be treated.

Activities Common to All Action Alternatives

Introduction

The information contained in this section describe activities that would occur across all action alternatives.

Slash Treatment

Slash created by these treatments could be removed offsite, piled and burned, chipped, and/or masticated. Where mechanized equipment is used, forest products would most likely be removed in the form of logs, chips, or firewood. After work is completed, firewood may be removed from the hand treatment units.

Design Criteria

Design criteria were developed to address site specific concerns and provide additional detail to the management activities described in the action alternatives in Section 2.3. Design criteria minimize the potential impacts the action alternatives may cause. This design criteria would be used during implementation of any of the action alternatives.

Road Actions

To decrease the risk of erosion and sedimentation and improve hydrologic function, approximately 6 miles of NFSR would be decommissioned and another 2.3 miles converted to administrative use only (not open to public travel). Any unauthorized roads on NFS lands not identified on the map but found during implementation would be decommissioned. These mileages effect only the portions that cross NFS lands and take into account the transportation system necessary for public access, motorized recreation, and forest management while also accounting for the effects the roads have on the watershed.

The town of Nederland and residents of the Big Springs Subdivision requested a special use authorization for emergency ingress/egress routes out of the subdivision to the south. There are two possible ingress/egress routes identified (Doe Trail, 0.72 miles, and Wildewood Trail, 0.36 miles), both currently existing as trails, that could be converted to NFSR for emergency ingress/egress purposes only. Road work would be done including widening, installing gates, and cutting all trees within the 30 foot road corridor. This clearing would be approximately 3.9 acres (2.6 acres along Doe Trail, 1.3 acres along Wildewood Trail).

Prescribed Broadcast Burning

Prescribed broadcast burning would be implemented across 968 mapped acres after the completion of mechanical/hand treatments that overlap the burn units. The location of the broadcast burn unit boundaries is based on control features surrounding the primary burn areas, including forest roads and Gross Reservoir. The burn would be broken up into six operational burn blocks ranging from 72-340 acres in size to reduce the number of acres burned at any one time to allow the area to recover. Implementation of the burn would be phased over a 3-5 year period of time to allow for recovery. The broadcast burn would focus on consuming up to 75% of the understory, including shrubs. Overstory mortality of up to 35% would be acceptable but not the focus of the broadcast burn.

Implementation
It is expected that implementation of the management activities could take 3 to 15 years to complete. The implementation of the proposed treatments would be completed by contractors and/or by USFS employees. The proposed treatments could be done by either mechanized equipment (mechanically) or hand crews with chainsaws (manually). Mechanized equipment operations are limited by the percent slope and amount of rock within a unit. Treatment units that are over 30% slope would be treated manually. However, there may be short distances within a unit where a machine could be working on slopes up to 40%. In some instances, a unit may be designated as a mechanical unit but there may be areas within the unit that are too steep or rocky for a machine to work. In those circumstances, these areas would be treated manually or left untreated to incorporate variable density within the area.

Defensible Space
Property owners in cooperation with the Colorado State Forest Service and Boulder County are continuing to create areas of defensible space around homes and other improvements on private lands. In order to comply with home insurance companies, some private landowners have been required to complete defensible space mitigation around their homes. Defensible space is the area around a home or other structure that has been modified to reduce fire hazard. In this area, natural and manmade fuels are treated, cleared or reduced to slow the spread of wildfire. Creating an effective defensible space involves a series of management zones where different treatment techniques are used.

Some of these private homes are in close proximity or adjacent to NFS lands. For vegetation treatments to be most effective for these private property owners, the treatments need to be applied in a manner and location that complements existing defensible space efforts on private land. Homeowners would have the ability to complete the required defensible space across their property boundaries onto NFS lands.

There are three zones that characterize defensible space and are defined as the following:

- Zone 1 is the area nearest to the structures that requires maximum hazard reduction. This zone extends up to 30 feet outward from a structure where the most flammable vegetation would be removed including most trees. Remaining trees would be pruned to a height of 10 feet from the ground and be spaced at least 30 feet, or more if on steep slopes, between crowns.

- Zone 2 is a transitional area of fuels reduction between Zones 1 and 3. Typically this zone should extend at least 100 feet from structures. Stressed, diseased, dead or dying trees would be removed along with ladder fuels. Trees would be thinned to a crown spacing of at least 10 feet, or more if on steep slopes. Retained trees would be pruned to a height of 10 feet from the ground. Groups of trees may be left in areas however these groups would have at least 30 feet spacing between the crowns of the group and any surrounding trees.

- Zone 3 is the area farthest from the structure. It extends from the edge of Zone 2 out to 300 feet from the structure. Crown space thinning between retained trees would be variable and based on steepness of slope. Ladder fuels would be removed from underneath retained trees. Retained trees would be pruned to a height of 10 feet if located along trails or firefighter access routes.

The dominant vegetation type (i.e. mixed conifer, lodgepole pine, and aspen) surrounding the structure would determine the prescriptions for the vegetation type to be cut by a permittee. Proximity of the structure to the boundary of NFS lands and average slope of the permitted area would also determine the intensity of the cutting. The defensible space prescriptions are not for restoration purposes; instead, they are intended for structure protection and may be more intensive than other prescriptions within the project area. All treatments would be completed manually (chainsaws) and treated material would be removed by hand. Skidding of material would not be allowed. All treated material would be transported to the permittee's land and the slash disposed of by the permittee. The prescriptions listed below are general in nature and assume the area is flat.

<u>Mixed Conifer Stands</u>:

- <u>Zone1:</u> All conifers less than 14 inches DBH would be cut and removed, and branches from the remaining trees pruned up to 10 feet from the ground. Aspen would not be cut unless it's to remove a "hung up" conifer or one that has been damaged during the felling activity.
- <u>Zone 2:</u> Conifers would be thinned to approximately 100 to 150 trees per acre (in a radius of 16.7 feet, 2 to 3 trees would be left) or less with at least a 10 foot crown spacing between the residual trees. The largest and healthiest (good vigor, at least 40% crown ratio, insect/disease, and damage free) trees would be retained while the stressed, diseased, dead, or dying trees would be removed along with ladder fuels. Retained trees would be pruned to a height of 10 feet from the ground. Species preference for cutting would be lodgepole pine, then Douglas-fir, then limber pine, and then ponderosa pine. Aspen would not be cut unless it's to remove a "hung up" conifer or one that has been damaged during the felling activity.

- <u>Zone 3:</u> Conifers would be thinned to approximately 250+ trees per acre (in a radius of 16.7', 5+ trees would be left) by cutting and removing the ladder fuels. The largest and healthiest (good vigor, at least 40% crown ratio, insect/disease, and damage free) trees would be retained while the stressed, diseased, dead, or dying trees would be removed along with ladder fuels (trees less than 6 inches DBH) would be targeted. Species preference for cutting would be lodgepole pine, then Douglas-fir, then limber pine, and then ponderosa pine. Aspen would not be cut unless it's to remove a "hung up" conifer or one that has been damaged during the felling activity.

<u>Lodgepole Pine Stands:</u>

- <u>Zone1:</u> All conifers would be cut and removed. Aspen would not be cut unless it's to remove a "hung up" conifer or one that has been damaged during the felling activity.
- <u>Zone 2:</u> Conifers would be thinned to retain groups of conifers (20 to 30 trees) and a crown spacing of 20 feet between the groups. Groups of trees instead of individual trees would be retained in order to reduce the potential for windthrow. Approximately 5 to 8 groups per acre would be left, and the groups would be arranged in a mosaic pattern (non-uniform). Within the groups all dead conifers and ladder fuels would be cut and removed. Aspen would not be cut unless it's to remove a "hung up" conifer or one that has been damaged during the felling activity.

- <u>Zone 3:</u> Conifers would be thinned to retain groups of conifers (40 to 60 trees) and a crown spacing of 20 feet between the groups. Groups of trees instead of individual trees would be retained in order to reduce the potential for windthrow. Approximately 3 to 4 groups per acre would be left, and the groups would be arranged in a mosaic pattern (non-uniform). Within the groups all dead conifers and ladder fuels would be cut and removed. Aspen would not be cut unless it's to remove a "hung up" conifer or one that has been damaged during the felling activity.

<u>Aspen Stands:</u>

Structures surrounded by aspen for 300 feet are rare, and most likely this prescription would be combined with one of the prescriptions identified above.

- Zone1: All conifers within the zone would be cut and removed. Aspen would not be cut unless it's to remove a "hung up" conifer or one that has been damaged during the felling activity.
- Zone 2: All conifers less than 16 inches DBH would be cut and removed, and branches from the remaining trees pruned up to 10 feet from the ground. Aspen would not be cut unless it's to remove a "hung up" conifer or one that has been damaged during the felling activity.
- Zone 3: All conifers less than 16 inches DBH would be cut and removed, and branches from the remaining trees pruned up to 10 feet from the ground. Aspen would not be cut unless it's to remove a "hung up" conifer or one that has been damaged during the felling activity.

Direct and Indirect Effects Common to All Action Alternatives

Silvicultural Effects of Reducing Tree Density

Tree thinning is perhaps the most critical silvicultural treatment available to restore individual tree health within a stand. However, increased health and vigor is usually not an immediate response. In the short term, thinning places an additional stress on residual trees, similar to other management activities. Therefore, thinning during non-drought periods would be advocated rather than waiting until mortality is detected (Smith 1997).

Disturbance dependent ecosystems require some type of interruption to create successional pathways, which re-organize plant communities. The body of forestry research shows how thinning stands helps reduces the incidence of damage to the stand. Less competition increases the health and vigor of the remaining trees, leading to a reduction of risk to bark beetle attack. Oliver and Larsen (1996) also state that stand density affects tree growth rates, vigor; cover for wildlife; fuels levels, fire potential and fire behavior; understory tree, shrub and herb density; and growth and yield of forest products.

As a forest grows trees become spatially crowded and fewer nutritional resources are available for each individual tree; leading to a decrease in tree and overall stand vigor. Reductions in stand density increase tree growth rates thereby enhancing the development of larger trees, and adding to the vigor of residual trees (greater crown mass for photosynthesis), which results in a proportional increase in overall stand health. The increase in stand health reduces the susceptibility of the stand to insects, drought and disease. Studies have found that growth in large older trees increases significantly when high densities of adjacent small stems are removed (Latham and Tappeiner, 2002).

An exhaustive body of research shows how thinning helps reduce the incidence of pest damage to a stand (Cochran and Barrett 1995). Less competition increases the health and vigor of the remaining trees reducing the risk of bark beetle attack. Growth rates would increase for residual trees within stands treated while tree mortality would decrease leading to lower dead fuel levels. Thinned stands would be more open, similar to historic conditions that were more resilient and sustainable against bark beetle attacks.

The primary goals of thinning are to provide for forest health and to reduce fuel loading. The direct effects of thinning would be increased stand and landscape level resiliency to fire, insects, and disease. Additionally, decreased stand densities would maintain healthy forest conditions during drought cycles. These effects would be apparent immediately following thinning.

Research has shown that active management through forest thinning maintains healthy trees that are less susceptible to high levels of mortality. Individual or small groups of trees may die, but the forest would be retained. Forests that are managed with appropriate residual density are able to withstand the effects of fire (Agee and Skinner 2005). Numerous research studies have shown positive effects to stand level resiliency from insect outbreaks, stand level forest diseases and fires burning beyond the range of historic norms. The treated stands of the Forsythe II project would be more resilient to common disturbance regimes within the Colorado Front Range.

Canopy cover would be decreased under most prescriptions, and the greatest decrease would be associated with prescriptions that receive the most thinning. The greatest decrease in canopy cover would be expected under Alternative 1, followed by Alternatives 2, 3, and 4 (even though Alternative 4 proposes to treat the same number of acres as Alternative 1, utilizing only manual treatment will not thin the overstory as extensively as with mechanical equipment; thus, less canopy cover would be reduced). Canopy cover reduction would be a short term decrease and would increase over the long term (varying from approximately 20-50 years depending on the tree species and also the type of treatment). Immediately post thinning, stands would be more open and then the growing space that is made available from the various types of thinning would again begin to be occupied by other vegetation, including new trees. Beyond the 20-50 year period, the canopy would re-grow into the open spaces and is likely to be close to the pre-treatment canopy cover condition.

Canopy is an expression of growing conditions, and while it is often used to quantify wildlife habitat it is an indirect measure related to forest vegetation due to the high variability in measures from point to point. Canopy is a result of stand structures during time of growth, and so crowed, dense stands may have less overall canopy than trees that are open grown. Canopy on individual trees is highly variable and depends a great deal on the light environment where the individual tree is growing. All of the action alternatives would reduce canopy cover more than the no action alternative, but this is a short term timeframe reduction. Over the long term, canopy would re-grow into the open spaces and is likely to be close to the pre-treatment amount over the long term time frame.

The action alternatives would maintain stands of trees in a healthy condition. In mixed conifer stands, thinning conifers would continue the progression toward a late-seral stage where thick bark provides more protection from fire damage.

Where equipment is utilized, there would be mixing of the forest litter layer with the mineral soil. The use of machinery to complete treatments would increase the potential for broken limbs and scraped bark on residual trees making them more susceptible to disease causing pathogens.

Mortality of residual trees from windthrow or from conifers “snapping off” at mid-trunk would be possible in the short term. The occurrence of windthrow and “snap off” would decrease over time as trees become more resistant to the wind. Tree regeneration within thinned stands would be more susceptible to dwarf mistletoe if dense concentrations exist in the overstory.

In the treated stands, lodgepole pine and Douglas-fir regeneration would be expected to occur within 2 to 10 years after treatment, depending on cone crops and climatic conditions. Ponderosa pine regeneration doesn’t occur as readily as the two other species. The time interval between substantial ponderosa pine cone crops is greater than the other two conifers. Ponderosa pine establishment is more dependent on the size of the cone crop, appropriate soil conditions, and moisture have to align in order to successfully regenerate. Douglas-fir is a prolific seeder and in many areas have outcompeted ponderosa pine regeneration on certain sites. In some cases, areas that had historically been dominated with ponderosa pine are now Douglas-fir stands even on southerly aspects. Douglas-fir is not as drought tolerant as ponderosa pine and with warming temperatures forecasted in the future, this poses a challenge to naturally re-establish ponderosa pine to its natural range without a seed source.

Dense regeneration of lodgepole pine in patch cut units would begin to occur soon after treatment (generally within 3 to 5 years). Where aspen exists it would be released to become a major stand component. Residual conifers would be arranged singly and in clumps at a variety of densities to increase stand complexity.

Ponderosa/Douglas-fir/Mixed Conifer

On the treated acres, varying age and size classes of ponderosa pine stands would remain. Stand composition post-thinning would favor ponderosa pine and aspen in the lower elevations and south and east aspects. Douglas-fir would be favored on north and west aspects with varying age and size classes. Residual conifers in the ponderosa pine and Douglas-fir cover types would be arranged singly and in clumps with a diversity of ages, sizes and densities. Various size openings would be created to maintain forest stand health and meet fuel reduction objectives. Trees with the greatest live crown would be left to take advantage of growing space, available water, sunlight, and nutrients. Healthy full crowned residual trees less than 100 years old would respond to thinning. The most notable response in growth of residual trees would be an increase in diameter that otherwise would occur at a slower rate in unthinned stands.

The stand attributes that result from thinning ponderosa pine stands closely match what is desired for old growth. Mature, larger, live trees would primarily be retained and the ones in decline may not be treated to provide for future snags and downed woody material. Younger healthy trees that are retained would increase in diameter due to the reduced competition than would naturally occur, and the enhancement of these younger trees provide for a multi-storied canopy.

All action alternatives would follow thinning regimes under prescriptions that would implement tree individuals and groups, gaps, and shrub patches as well as provide for the opportunity for natural regeneration across the treated stands.

Thinned ponderosa pine stands would have increased resistance to insect attacks in the long term. In the short term, populations of *Ips* beetles could would in the piled slash potentially making isolated residual trees susceptible to insect attacks. Once the slash is treated, this threat would no longer be present. Residual trees would have more available nutrients, sunlight, growing space and moisture allowing the conifers to be more resistant to *Ips* beetle attacks.

Mistletoe levels would be reduced slightly but would persist in endemic levels. The removal of a laddered forest canopy (vertically adjacent canopy layers) in thinned Douglas-fir stands would deter spruce budworm. Thinning would impede the horizontal and vertical movement of the defoliating larval stage of the budworm.

The greatest resilience and healthiest mixed conifer stand conditions would be expected under Alternative 1, followed by Alternatives 3, 2, and 4. Alternative 4 proposes to treat the same number of acres as Alternative 1, utilizing only manual labor with chainsaws, will not thin the overstory as extensively as with mechanical equipment; thus, less acres would be effectively treated to maintain stand resilience and a healthy forest condition over time.

Lodgepole pine

Lodgepole pine stands would be more susceptible to windthrow than ponderosa pine stands or mixed stands. Lodgepole pine trees do not have a tap root like ponderosa pine or Douglas-fir, which reaches generally straight down into the soil and provides more stability to the tree. This, in combination of shallow soils that are generally associated with lodgepole pine stands, makes lodgepole pine trees more susceptible to windthrow.

Partial cutting (thinning) increases the risk of windthrow in lodgepole pine because the entire stand is opened up and the residual trees are vulnerable to winds that they weren't exposed to in an untreated condition. Less damage is associated with clear/patch cutting because the only the boundaries between the cut and uncut areas are vulnerable.

Clear cutting and patch cutting results in moderate to extensive disturbance of the understory vegetation where present. Generally, within two to five years after cutting, the understory vegetation begins to grow back and dominates the ground surface. A mixture of planted conifers (ponderosa pine, limber pine, and Douglas-fir) would compete for dominance with the anticipated lodgepole pine natural regeneration. New stands arising from clear cutting and patch cutting would exhibit a single canopy layer and uniform size and age classes until future treatments are implemented where tree stratification would occur.

Edges of clearcut and patch cut units would be feathered and scalloped to create a near natural appearance and comply with retention partial retention visual requirements from the Forest Plan. These feathered edges of the clearcut and patch cuts would be at greater risk to windthrow than straight-line edges.

Stands of dense, young regeneration (approximately 2 to 15 feet tall) would be thinned to a range of 10 to 15 foot spacing to maximize residual tree growth. Trees with the greatest live crown would be left to take advantage of growing space, available water, sunlight, and nutrients. Thinning would reduce tree-to-tree competition, increase tree vigor and provide an enhance ability of trees to defend against a MPB attack. Thinning these young stands would also allow the diameters of the residual trees to grow quicker and reduce the risk of snow breakage.

Alternative 1 would create the greatest heterogeneous pattern of lodgepole pine stands throughout the general forest to provide a discontinuous crown level and a greater resiliency to large disturbances followed by Alternatives 4, 3, and 2.

Quaking Aspen

Aspen restoration would increase tree heath and vigor of the species, as well as provide hormonal stimulation within the treated stands. Risk to loss would be decreased initially, and more over time. Large older trees may become more vigorous initially but eventually they would become snags and downed wood, all contributions to a healthy habitat within the aspen clone. The aspen clone system would be stimulated by the removal of competing vegetation, ground scarification, and prescribed fir entries. Sprouting is anticipated to be greater, leading to a higher survival rate for young aspen. This would result in numerous young trees that would grow rapidly and then begin stem differentiation as time passes. A multi-storied stand would be expected within the long term time frame. Removal of conifer species would create high light conditions, and stand soils would be appreciably warmer due to increased solar radiation. The combination of reduced competition, higher sunlight levels and increased clone health would allow for vigorous sprouting (Shepperd 2006(b)). Aspen clones would become larger, and the overall size of the clone would be discernible within one to two years as a result of implementing these treatments.

Alternative 3 would treat the most acres to encourage and increase the landscape heterogeneity and complexity resulting in a greater variety of environments and increased diversity followed by Alternatives 1, 4, and 2.

Meadows and Shrublands

Meadow restoration efforts associated with the proposed action would effectively assist in removing the smaller size class from the identified meadows/shrublands treatment areas. Removal of these smaller size classes of trees would result in less water use in the meadows/shrublands, now and over time. Small tree removal by chainsaw would prevent equipment entry into the meadows/shrublands areas, effectively preventing soil compaction and hydrologic changes.

The treatment proposal of thinning up to a maximum diameter for ponderosa pine, Douglas-fir and lodgepole pine would not remove the largest trees. Larger trees removal would likely result in achieving greater restoration of the meadows/shrublands; however these trees are being left for wildlife and also to avoid mechanical entry into sensitive areas. Trees up to the diameter limits are being proposed for removal to prevent further encroachment by large trees into the meadows/shrublands vegetation types, as these trees that are currently small would grow larger in the long term time frame. Efforts to restore the meadows/shrublands under this proposed action would result in a greater likelihood of a meadows/ shrublands system dominated by herbaceous and shrub vegetation in the long term time frame. Some meadows/shrublands systems would increase in size as a result of removing encroaching conifers, and the overall size would begin to be noticed within three or more years after treatment.

Alternatives 1and 4 would treat the most acres to enhance and maintain larger meadows and shrublands that would play an important role for wildlife species that need open areas for foraging or nesting, and also influence disturbance processes such as crown-fire, insects, and disease followed by Alternatives 2 and 3.

Old Growth

There are currently between 695 and 890 acres (depending on the action alternative) of units that are identified as old growth or potential old growth. Thinning to leave and create new 3B and 4B structural stages, there would be opportunities to provide for future stand development into old growth as these stands mature. These stands would be needed to increase the amount of late successional stands and replace existing late successional stands as they deteriorate or are lost through fire, insects or other natural events. Acres of old growth proposed for treatment would be designed to enhance old growth characteristics and promote the existence of the stand over time. Lodgepole pine old growth would not be treated in Management area 3.5.

Alternatives 1, 3, and 4 would equally treat the most acres to enhance and maintain old growth conditions in ponderosa pine dominated stands followed by Alternative 2.

Prescribed Fire

All of the action alternatives would utilize a combination of mechanical equipment and hand crew labor (manual) to reduce fuel loadings within unit boundaries and reduce the potential for crown fire initiation and spread under a wildfire setting. Slash would be hand piled in manual units and burned when the piles have cured and conditions are within the burn prescription. Scorching of individual conifer crowns may occur depending on their proximity to the pile, density of crown, and wind speed during the burning operations. This would raise individual crown base heights and sometimes remove the branches on the side of residual trees; however, tree mortality from pile burning would be minimal.

Machine piles created from a mechanical treatment would be located on landings and generally would not impact residual conifers during burning operations. However, some conifers directly adjacent to the landing may show signs of radiated heat depending on the conditions when the piles are burned.

The effects of prescribed broadcast burning on the existing vegetation would result in a mosaic of fire intensity. Low to moderate intensity surface fire would thin (kill) some of the younger trees, prune lower branches, and consume flashy fine fuels such as ground juniper and small diameter dead and down material that could contribute to fire spread in the event of a wildfire.

Although the same fire mitigation effects are desired for thinning and prescribed fire, the effects of these treatments are variable. Unlike mechanical thinning treatments, prescribed fire is not exact and cannot guarantee the removal or survival of individual trees. Prescribed fire does not allow for much control over tree species and size class selection. Due to the controlled intensity of prescribed fire as compared to a wildfire, mature and larger conifers are more resilient to the effects of a burn.

Secondary fire effects can result in damage and stress to trees that may become susceptible to mountain pine beetles. Due to a number of factors including the time of year when the prescribed burn occurs, the continuity of fuels, fuel moisture, air temperature, wind, fire intensity, and fire effects can be quite variable across a treatment area. The effects would be highly variable ranging in areas where signs of burning are negligible to areas where torching and the loss of single and sometimes groups of over-story trees. Prescribed broadcast burning would increase the sprouting of hardwoods, shrubs, and noxious weeds. Mortality is expected in small trees and fire scars may occur on larger conifers. The structural forest diversity resulting from prescribed fire may mimic the natural fire regime that occurred historically in the lower montane of Colorado’s Northern Front Range.

All of the proposed action alternatives treat the same amount of acres with prescribed broadcast burning.

Roads

Maintenance of existing roads within mechanical unit boundaries would be required to implement this project. Openings of up to 12 feet (projected road width prism) would be created in the stand crown as a result of road maintenance if the condition of the road is not already set to this standard.

For the emergency roads providing ingress/egress to the Big Springs Subdivision, a clearing of trees 30 feet wide including the roadbed. This clearing would be approximately 3.9 acres (2.6 acres along Doe Trail and 1.3 acres along Wildewood Trail). Windthrow of remaining trees is expected to be minimal given the north/south general direction of the proposed roadways as compared to the west/east predominant wind patterns.

Landings, generally up to 1 acre in size would be created for the implementation of the mechanically treated units within the project area. Approximately 1 landing for every 10 to 30 acres of treated area would be needed and made to complete the operations. These areas and roads that are utilized to access the landings would have soil compaction until they are restored upon completion of the project. Some conifer mortality may occur directly adjacent to the temporary roads and landings due to lateral soil compaction.

Although minimal damage to trees adjacent to system roads that have overgrown or are not currently at the forest standards, the maintenance (including roadbed preparation and soil compaction) may damage tree roots. Tree injuries related to road maintenance and landing sites may provide entry points for pathogens. These effects would be expected in trees immediately adjacent to the system roads and adjacent to landings only.

Alternatives 1 and 2 would equally treat the greatest miles of temporary roads followed equally by Alternatives 3 and 4. All of the proposed action alternatives treat the same miles of ingress/egress administrative roadway for the Big Springs Subdivision as well as the number of miles of existing road that would be decommissioned.

Defensible Space

The direct and indirect effects for units identified with defensible space prescriptions would be similar to the effects identified for each primary forest cover type (above). All prescriptions would be treated manually so the effects reflective of mechanical treatments (ie. compaction) would not be applicable. Alternative 2 would allow the greatest amount of potential acres for private residences to complete defensible space mitigation on NFS lands followed by Alternatives 3, 1, and 4.

Habitat Structural Changes Comparison

The existing and expected post treatment cover types and the associated HSS within the treatment units are summarized for all of the action alternatives in Tables 11-14. The most dramatic change would occur in the lodgepole pine stands that are treated with clear/patch cutting. Thinning primarily affects the understory but a measurable change to canopy closure and the HSS occurs. In ponderosa pine and Douglas-fir cover types, the effects of thinning would potentially change from a high to moderate closure and from a moderate to low closure. Due to an increase in available soil moisture and sunlight, a minor increase in aspen cover would be anticipated in most of the treatment areas where aspen is present.

Table 11 - Changes in HSS from Alternative 1 Treatments

Tree Cover Type		1M Acres	2T Acres	3A Acres	3B Acres	3C Acres	4A Acres	4B Acres	4C Acres	Summary Total Acres
Grass	Pre Treat	259								259
	Post Treat	274								274
Lodgepole Pine	Pre Treat		17	105	533	196	97	441	26	1,415
	Post Treat		715	57	267	94	49	219	13	1,414
Ponderosa Pine	Pre Treat			200	166		255	292		913
	Post Treat		0	366	0	0	531	5		902
Douglas-fir	Pre Treat			157	324	32	107	280	144	1,044
	Post Treat		2	474	26	8	362	149		1,021
Aspen	Pre Treat		31	106	55	36	8	7		243
	Post Treat			198	45		19			262
Spruce-fir	Pre Treat						3			3
	Post Treat						3	0		3
Pre Treat Total		259	48	568	1,078	264	470	1,020	170	3877
% of Total Tree Cover		6.7%	1.2%	14.7%	27.8%	6.8%	12.1%	26.3%	4.4%	
Post Treat Total		274	717	1,095	338	102	964	373	13	3876
% of Total Tree Cover		7.1%	18.5%	28.3%	8.7%	2.6%	24.9%	9.6%	.3%	

8 ac NBA, NRK, WAT
Total summary difference due to rounding

Table 12 - Changes in HSS from Alternative 2 Treatments

Tree Cover Type		1M Acres	2T Acres	3A Acres	3B Acres	3C Acres	4A Acres	4B Acres	4C Acres	Summary Total Acres
Grass	Pre Treat	254								254
	Post Treat	262								262
Lodgepole Pine	Pre Treat		10	69	375	123	71	326	11	985
	Post Treat		311	52	255	84	49	227	8	986
Ponderosa Pine	Pre Treat		0	194	157		222	253		826
	Post Treat		0	351	0		471	4		826
Douglas-fir	Pre Treat			119	264	26	80	194	121	804
	Post Treat		3	378	27	4	217	166		795
Aspen	Pre Treat		14	90	35	29	8	3		179
	Post Treat			143	32		3			178
Spruce-fir	Pre Treat							1		1
	Post Treat							1		1
Pre Treat Total		254	24	472	831	178	381	777	132	3,049
% of Total Tree Cover		8.3%	.8%	15.5%	27.3%	5.8%	12.5%	25.5%	4.3%	
Post Treat Total		262	314	924	314	88	740	398	8	3,048
% of Total Tree Cover		8.6%	10.3%	30.3%	10.3%	2.9%	24.3%	13.1%	.3%	

6 ac NBA, NRK, WAT
Total summary difference due to rounding

Table 13 - Changes in HSS from Alternative 3 Treatments

Tree Cover Type		1M Acres	2T Acres	3A Acres	3B Acres	3C Acres	4A Acres	4B Acres	4C Acres	Summary Total Acres
Grass	Pre Treat	260								260
	Post Treat	262								262
Lodgepole Pine	Pre Treat		18	57	348	69	88	239	22	841
	Post Treat		384	61	191	33	44	118	10	841
Ponderosa Pine	Pre Treat		0	200	147	0	244	235		826
	Post Treat		0	362	0		459			821
Douglas-fir	Pre Treat			127	317	12	88	250	115	909
	Post Treat		3	440	18		312	136	0	909
Aspen	Pre Treat		31	103	64	35	8	7		248
	Post Treat			200	43		5			248
Spruce-fir	Pre Treat							1		1
	Post Treat						0.5	0.5		1
Pre Treat Total		260	49	487	876	116	428	732	137	3,085
% of Total Tree Cover		8.4%	1.6%	15.8%	28.4%	3.8%	13.9%	23.7%	4.4%	
Post Treat Total		262	387	1,063	252	33	821	255	10	3,082
% of Total Tree Cover		8.5%	12.6%	34.5%	8.2%	1.1%	26.6%	8.3%	.3%	

11 ac NBA, NRK, WAT
Total summary difference due to rounding

Table 14 - Changes in HSS from Alternative 4 Treatments

Tree Cover Type		1M Acres	2T Acres	3A Acres	3B Acres	3C Acres	4A Acres	4B Acres	4C Acres	Summary Total Acres
Grass	Pre Treat	259								259
	Post Treat	274								274
Lodgepole Pine	Pre Treat		17	105	533	196	97	441	26	1,415
	Post Treat		444	76	366	136	68	305	18	1,413
Ponderosa Pine	Pre Treat		0	200	166	0	255	292		913
	Post Treat		0	336	28		495	40		899
Douglas-fir	Pre Treat			157	324	32	107	280	144	1,044
	Post Treat		3	463	42	3	201	290	21	1,023
Aspen	Pre Treat		31	106	55	36	8	7		243
	Post Treat			167	62	11	25	2		267
Spruce-fir	Pre Treat							3		3
	Post Treat							3		3
Pre Treat Total		259	48	568	1,078	264	467	1,023	170	3,877
% of Total Tree Cover		6.7%	1.2%	14.7%	27.8%	6.8%	12%	26.4%	4.4%	
Post Treat Total		274	447	1,042	498	150	789	640	39	3,879
% of Total Tree Cover		7.1%	11.5%	26.9%	12.8%	3.9%	20.3%	16.5%	1.0%	

8 ac NBA, NRK, WAT
Total summary difference due to rounding

Cumulative Effects Common to All Action Alternatives

The cumulative effects analysis for this specialist report considers projects that were within the recent past (approximately last 20 years), present, or are reasonably foreseeable future (next 1-5 years). The time frames were selected in an effort to report accurate information.

Cumulative impacts, for the purposes of this vegetation report, are those activities that specifically impact the vegetation resource. These activities would change trees per acres, basal area, canopy cover, and other associated vegetation attributes. Activities that have no measurable impacts to vegetation include grazing and motorized vehicle use. Vegetation cumulative effects are additive, meaning they accumulate and can be summarized as total changes across varying scales. At the landscape scale, anecdotal references to changes in vegetation by project are discussed when site specific information is lacking. Since vegetation is dynamic, time elapsed since treatment as well as varying treatment methods create a situation that makes site specific scientific analysis complex as well as time and labor intensive.

Changes in the coniferous forest through varying vegetation management practices (thinning regimes and fuels treatments) have the greatest potential for cumulative effects on fire severity, vegetation structure and ecological restoration. In treated mixed conifer stands, regardless of thinning regimes applied, result in decreased crown bulk density, higher canopy base heights, and may have reduced surface fuel loadings. There is an associated reduction in crown fire potential (Collins et al 2011, Agee and Skinner 2005). In treated lodgepole stands where patchcuts and clearcuts are prescribed, discontinuous crowns and various vertical stand structure would create a diverse mosaic of forest complexity across the landscape.

Past Projects, Events and Actions

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 as a proxy for the impacts of past actions. This is because existing conditions reflect the aggregate impact of all prior human actions and natural events that have affected the environment and might contribute to cumulative effects.

Below is a list of the past projects, events, and actions that have occurred within or adjacent to the Forsythe II analysis area that involved vegetation and ground disturbing effects:

- Forsythe Fuels Reduction Project (thinning, patchcutting, clearcutting, pile burning) – 2012
- Lump Gulch Fuel Treatment Project (thinning, patchcutting, clearcutting, pile burning) – 2009
- Residential Development
- Mining – test pits and minor operations
- Fourmile Fire (6,181 ac) – 2011; Black Tiger Fire (1,804 ac) – 1989; Cold Springs Fire (528ac) - 2016
- Winiger Ridge Ecosystem Mgmt. Project (thinning, patchcuts, pile and broadcast burning) – 2001
- Fuels treatments on private property and Boulder County lands
- Timber stand improvement (lodgepole regeneration thinning)
- Campsite and parking area construction in Winiger Ridge area – 2010
- Forest-wide Hazard Tree Removal – 2010
- Emergency Power Line Clearing Project – 2010

Within the last 20 years, there have been previous thinnings, patchcuts, clearcuts, and prescribed fire (both broadcast and pile burning). The cumulative effects of these treatments and those currently proposed are not expected to negatively affect vegetation. Many treatments were designed to lower the basal area to promote increased growth and vigor as well as regenerate the stands. The proposed treatments are expected to improve conditions for conifers, aspen, and shrub species respectively by reducing competition for sunlight, water, and soil nutrients.

The effect of past treatments has been an increase of individual tree volume growth and increase in the wood quality. The past treatments have reduced the stocking levels in overstocked stands. The effect has been an increase in the quality of the conifer component through the removal of damaged, diseased, and poorly formed trees. There has been an increase in individual tree growth by releasing the remaining trees from competition for light, water and nutrients. Conifers have developed larger diameters due to a reduction of competition. A reduction of the hazard to the pine stands due to the reduction of basal area below the level of susceptibility to pine beetle attack has also occurred for stands which have recently been treated.

Present and Reasonably Foreseeable Actions

Within the Forsythe II Project landscape, there are only a few vegetation management activities (slash pile disposal) that still need to be completed from the Forsythe Fuels Reduction Project.

Below is a list of the current projects, events, and foreseeable actions that have occurred within or adjacent to the Forsythe II analysis area:

- Eldora Ski Area Operations and Proposed Expansion – 2015
- Denver Water/FERC – Gross Reservoir Expansion
- Boulder County Reynold's Ranch Fuels Project
- Residential and other development on private land
- Annexation of property in Town of Nederland near high school
- Timber stand improvement (lodgepole regeneration thinning) of clearcut/patchcut lodgepole pine stands
- Fuels treatments on private property and Boulder County lands

Currently, there are only a few vegetation management activities that are occurring on NFS lands within the Forsythe II Project area including slash pile disposal, removal of hazard trees along roads and trails, and sporadic fuelwood gathering. Fuel reduction work (mechanical and manual treatment and prescribed burning) would continue to be implemented in the Lump Gulch Fuels Reduction Project. Due to the intensity of planned treatments within the Lump Gulch Project (thinning, patchcuts and clearcuts), there are and would be changes to tree density and stand canopy within the units of that project. In the patchcuts and clearcuts of lodgepole pine dominated stands, conifers of mixed species were/will be planted to provide diversity for forested stands in the future.

Boulder County and private lands comprise 48 percent of the project area (9,098 acres) and most of these areas are forested. Fuel reduction mitigation conducted by Boulder County Parks and Open Space on their lands would be expected to continue on their respective land bases, and due to the intensity of their treatments, the effects of forest management practices could affect the project area.

With an increasing interest from landowners to manage their forested land, protect their property from wildfire and clear land for home sites, acres on private lands may be treated within the next decade. These mitigations could result in additional scattered openings, lower basal areas, and the reduction of both surface and aerial fuel loadings. Since the amount of silvicultural activities not connected to this analysis would be minimal, the cumulative effects of these activities under any of the alternatives would also be minimal.

Through the suppression of wildfires, vegetation and stand structure diversity has been altered. It is expected that wildfires would continue to be suppressed in the future to protect other resource values and uses. Consequently, the vegetation and stand structure in both treated and untreated areas within the analysis area would become less diverse over time. The wildland fire management strategy for the Forsythe II analysis area is expected to be direct control. Because of increased development on private lands over the years, there has been an increase in fire suppression activities, limiting the amount of stand replacing events. Wildfires would continually be suppressed to protect property and other resource values and uses. As a result of fire suppression activities and the fire size history (Armstrong 2016), vegetation structure changes would generally be unchanged except in specific areas when weather conditions are conducive for a fire that is not contained in initial attack.

The lower montane area within the Forsythe II Project has missed some fire cycles, and this has resulted in a change to the spatial distribution, composition, and density of vegetation. Shade tolerant species have become more numerous, and larger through time than would be likely if fires were ignited and allowed to burn. Effects of fire exclusion are not easily quantified because there is a complex and dynamic relationship between a variety of factors that influence fire extent, severity and overall impact. Some of these factors are season of burning, fire weather, fuel moisture, aspect, slope and vegetation structure, composition and density. Fuels in the form of live and dead vegetation are greater in scenarios where fires are continually suppressed. Therefore, a net overall effect of fire exclusion cannot be quantified, but should be considered as an effect in regards to vegetation.

The upper montane landscape within the project area is in line with the historical range of variability. The vegetation composition, spatial distribution, and density is what is expected in an upper montane forest environment. However, with expected changes in climate, fire return cycles may become shorter in the future.

The Gross Reservoir project has been proposed to raise the pool height of Gross Reservoir up to 120 feet above its current elevation. The result of this action would be the removal and subsequent inundation of vegetated areas on all ownerships adjacent to the reservoir, including those on National Forest System lands.

The area and timeframes for the cumulative effects analysis for vegetation would be the same for all of the Action Alternatives. The primary activities that contribute to vegetation cumulative effects include past fuels mitigation on NFS lands, Boulder County lands and private lands. Each Action Alternative is expected to contribute to varying levels to the overall cumulative effects, and this will be determined by the number of acres that are treated in each alternative. The greatest cumulative effects to vegetation while meeting the objectives stated in the Purpose and Need would be found in Alternative 1 followed by Alternatives 4, 3, and 2.

There are no known irreversible effects to vegetation from the action alternatives. There are no known irreversible effects to vegetation if the No Action Alternative is implemented. However, there would be an irretrievable loss in tree health, resulting in a loss in growth and vigor (when compared to the Action Alternatives) in overcrowded stands. The risk of irretrievable effects to vegetation is reduced within the proposed units in all action alternatives because of the reduced risk of crown fire. Areas outside of the treatment units on NFS lands would have an increased risk or irretrievable effect to vegetation if a stand replacing wildfire occurred in the analysis area.

Monitoring

The objective of monitoring for the silvicultural resource will be to:

1. Insure that decisions made as a result of the analysis are implemented.
2. Determine the effects of harvest activities and related treatments identify adverse impacts and mitigate if necessary.

During timber sale layout and marking, internal oversight by the Prep Forester and/or Silviculturist will be made to insure that marking and layout follows decisions made and mitigations outlined in the analysis. Minor changes involving stand inclusions may require changing marking techniques, while major changes will be evaluated and recommendations made to the District Ranger to determine the appropriate course of action.

Throughout the implementation of the proposed treatments, the activities would be administered by Sale Administrators (SA), Contracting Officer Representatives (COR) or other qualified USDA Forest Service specialists who monitor the design criteria and mitigations identified for this project. During the timber harvesting activities, additional inspections will be made by the district Silviculturist and/or silviculture technician to insure harvest activities are accomplishing the objectives and mitigation specified. Inspections will also provide feedback for future project analysis.

All of the Action Alternatives would require monitoring treatment units for the evidence of *Ips* during and after implementation is complete (once a year for up to 2 years post treatment). During treatment, observations would be made to determine the impact of *Ips* both in green slash and residual trees. The risk of *Ips* is reduced once the slash has dried.

In stands dominated with lodgepole pine, observations would be made to assess the extent of windthrow. Windthrow generally occurs within 3 years post treatment. If more than 10% of an area has windthrown trees, an assessment would be made for follow up actions (i.e. tree removal, chipping, piling).

In patchcuts and clearcuts, regeneration must be established within 5 years after treatment (National Forest Management Act). Tree planting would occur in all of the patchcuts and clearcuts greater than 3 acres in size. Observations would be evaluated to assess the stocking level (minimum of 150 trees per acre over 50% of the treated area). Patchcut and clearcut units would be conducted at 1 and 3 years post planting to evaluate stocking. Upon completion of the surveys, the district Silviculturist will certify those stands that have adequately regenerated.

Records of surveys and findings generally will be recorded and filed in the district stand files located at the Boulder Ranger District Office. Summaries of accomplishments will also be reported electronically in the FACTS database on the Arapaho and Roosevelt National Forest for upward reporting and district use.

Summary

Alternative 1 most fully complies with applicable management direction for this project. The direct, indirect and cumulative effects of alternative 1 most fully meet the purpose and need for this project, as well as most fully comply with applicable management direction. The No Action Alternative does not meet the purpose and need of this project, but was analyzed to show how a course of no action indicator measures compare to action alternatives. Alternative 2 meets some of the objectives of the purpose and need for this projects, but with modified treatment intensities and quantities. Alternative 3 addressed wildlife, soils, and hydrology concerns with the number of units to be treated and incorporated public comments and additional units. Alternative 4 addresses the purpose and need objectives for this project, but all of the proposed vegetation treatments, with the exception of the units to be patchcut or clearcut, would be implemented with manual crews utilizing chainsaws which aren’t as efficient or ecologically sound due to the need for increased hand piles that would be needed to address the fuels across the entire project area.

All of the action alternatives accomplish ecosystem restoration objectives with the use of fire in prescribed broadcast burn units in the lower montane zone. All of the action items would allow for private residents to complete defensible space mitigation on NFS lands where their private structures are within the defensible space zones identified in the Colorado State Forest Service guidelines. Limited aggregations on the landscape, aspen clones and meadows/shrublands would be enhanced and expanded in all action alternatives.

The Forsythe II Project area in the lower montane has departed from historic conditions and fuels and vegetation densities are higher than in historic times. In the upper montane vicinity of the Project area, the vegetation has not departed from historic conditions. Factors such as increased human use, climate change and other anthropogenic factors place stressors on the vegetation as well as create heighted risk for wildland fire starts. Successful suppression efforts have resulted in a fuels buildup, and skewed vegetation composition and structure in various locations within the Project area.

The desired condition for the vegetation resource, including fuels is a fire resilient, multi-aged structure across vegetation cover types that represent a variety of habitats. Ideally, this condition would resemble a forest structure that functioned similar to pre-settlement conditions yet adapts for fluctuations and variance in face of a changing climate. Restoration activities would provide a landscape-level resilience to disturbance. Changes in forest composition and configuration have led to decreased resilience to historical disturbance agents.

Almost the entire area within the Forsythe II Project is identified as WUI. Research has shown that thinning treatments at higher elevations of the montane zone will not return the fire regime to an historic low-severity, regime. However, in a heavy populated WUI environment, canopy separation and a modified forest structure minimizes and modifies the impacts of a devastating wildfire. Thinning, clearcuts and patchcuts would not prevent a wildfire but it would reduce the severity and intensity of a wildfire by modifying the fire progression.

Vegetation treatments and prescribed broadcast burning would provide for the implementation of effective suppression strategies in the event of a wildfire. In a wildfire scenario, large openings and thinned stands would allow for aerial resources to effectively support ground crews and possibly provide additional time for people who need to evacuate their homes. Forest restoration objectives are secondary to WUI objectives in highly populated areas regardless of what life zone proposed treatments are located.

The action alternatives, at various levels, would implement vegetation restoration and fuels management prescriptions that would allow successional pathways to become less limiting, which is likely to result in vegetation community changes within the treated stands. Shade intolerant tree species would become more numerous and large and understory vegetation communities would become more numerous. The Forsythe II Project seeks to restore ecosystem function and process by implementing management actions, which would reduce the number of trees and selectively thin shade tolerant species. Ecosystem resilience to catastrophic events would be increased.

The proposed action is designed to consider all resources and seeks to treat the landscape so that a wide variety of ecosystem services can be provided over the long term time frame. Vegetation and fuels management activities pursued as part of the proposed action are intended to manage accumulated fuels by removing them from site to the greatest extent practicable, change existing vegetation successional pathways and restore a resilient, multi-aged and multi-structured forest condition where possible.

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Appendix A Glossary (Terms, Abbreviations, and Acronyms)

Activity Fuels – Fuels resulting from or altered by forestry practices, such as timber harvest or thinning, as opposed to naturally created fuels.

Age Class – Groups of trees or shrubs approximately the same age.

Aspen clone – Analogous to aspen 'stand' and aspen 'community'. Unique habitat occupied by aspen (*Populous tremuloides)*.

At-Risk Community – As defined by the HFRA, Title I, Section 101, (1), the term "at-risk community" means an area:

(A) that is comprised of

(i) an interface community as defined in the notice entitled "Wildland Urban Interface Communities Within the Vicinity of Federal Lands That Are at High Risk From Wildfire" issued by the Secretary of Agriculture and the Secretary of the Interior in accordance with title IV of the Department of the Interior and Related Agencies Appropriations Act, 2001 (114 Stat. 1009) (66 Fed. Reg. 753, January 4, 2001); or

(ii)a group of homes and other structures with basic infrastructure and services (such as utilities and collectively maintained transportation routes) within or adjacent to Federal land;

(B) in which conditions are conducive to a large-scale wildland fire disturbance event; and

(C) for which a significant threat to human life or property exists such as a result of a wildland fire disturbance event.

Basal Area (BA) – 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.

Biological diversity – The full variety of life in an area including the ecosystems, plant, and animal communities; species and genes; and the processes through which individual organisms interact with one another and with their environments.

Broadcast Burn – Controlled application of fire to fuels in either their natural or modified state (such as slash), under specified environmental conditions that allows the fire to be confined to a predetermined area, and produce the fire behavior and fire characteristics required to attain planned fire treatment and resource management objectives.

Canopy – The cover by vegetation and/or branches. Often but not always restricted to the tree layer or greater than six feet tall.

Canopy Closure – The percentage of the ground and/or sky covered by vegetation and/or branches.

Canopy Layer – Cover by vegetation and branches in different height intervals. These intervals are often defined in terms of vegetation, such as herbaceous or grass/forbs less than two feet tall, shrubs less than six feet tall, and overstory greater than six feet tall.

Clearcut (clearcutting) – The removal of the entire stand in one cutting with reproduction obtained artificially or from seeds germinating after the clearing operation.

Common Stand Exams (CSE) – Inventory plots installed to collect stand data and information.

Community Wildfire Protection Plan (CWPP) – As defined by the HFRA, Title I, Section 101, (3), the term "community wildfire protection plan" means a plan for an at-risk community that:

(A) is developed with the context of the collaborative agreements and the guidance established by the Wildland Fire Leadership Council and agreed to by the applicable local government, local fire department, and State agency responsible for forest management, in consultation with interested parties and the Federal land management agencies managing land in the vicinity of the at-risk community;

(B) identifies and prioritizes areas for hazardous fuel reduction treatments and recommends the types and methods of treatment on Federal and non-Federal land that would protect one or more at-risk communities and essential infrastructure; and

(C) recommends measures to reduce structural ignitability throughout the at-risk community.

Condition Class – Condition classification is defined as a qualitative measure describing the degree of departure from historical fire return intervals and measuring the risk of losing key ecosystem components such as species composition, stand age, and canopy closure. One or more of the following activities may have caused this departure: fire suppression, timber harvesting, livestock grazing, introduction and establishment of exotic plant species, introduced insects or disease, or other past management activities.

Conifer – Cone-bearing trees, mostly evergreen, such as pine, spruce, fir, and juniper.

Cover Type – The vegetative species that dominates a site. Cover types are named for one plant species or non-vegetated condition presently (not potentially) dominant, using canopy or foliage cover as the measure of dominance. In several cases, sites with different species dominant have been lumped together into one cover type; co-dominance is not necessarily implied.

Crown – The upper part of a tree or other woody plant carrying the main branch system and foliage and surmounting at the crown base a more or less clean stem.

Crown/Canopy Bulk Density – A relative measurement of the total crown area compared to the overall land area in a given area.

Crown Density - The thickness both spatially in depth and in closeness of growth of an individual crown, such as its opacity as measured by its shade density.

Crown Height – For a standing tree, crown height is the vertical distance from ground level to the base of the crown, measured either to the lowest live branch-whorl or to the lowest live branch, excluding shoots arising spontaneously from buds on the stem of a woody plant or to a point halfway between.

Defensible Space – Defensible space is an area between houses/structures, which is either man-made or natural where the vegetation is modified and maintained to slow the rate and intensity of an oncoming wildfire. It also provides an opportunity for firefighters to work and defend the house and helps protect the surrounding forest from igniting in the event of a structure fire.

Desired Future Condition –

- A portrayal of the land or resource conditions that are expected to result if goals and objectives are fully achieved.
- A description of the landscape as it could reasonably be expected to appear at the end of the planning period if the Plan's goals, objectives, standards, and guidelines for that landscape are fully achieved.

Diameter @ Breast Height (DBH) – height where tree diameter is normally measured (specified as 4.5 feet above ground base of the tree).

Diversity – Diversity refers to the distribution and abundance of different plant and animal communities and species within the area covered by a land and resource management plan (LMRP). This term is derived from the National Forest Management Act (NFMA).

Fire Regime – Fire regime class is defined as the fire return interval (frequency) and expected severity of a fire in different vegetation types.

Fire Risk – The chance of a fire starting, as affected by the nature and incidence of causative agents, including lightning, people, and industry. Three risk scales are used: high, moderate, and low. High-risk areas include locations where lightning, people, or industry have commonly caused fire in the past; moderate-risk areas include locations where lightning, people, or industry have periodically caused fire in the past; and low-risk areas include locations where lightning, people, or industry have infrequently caused fire in the past.

Fuel Breaks – Generally wide strips of land 60 to 1,000 feet in width where native vegetation has been modified so that fires burning into them can be more readily controlled. Some fuel breaks contain fire lines such as road or hand lines that can be widened.

Fuel Continuity – Degree or extent of continuous or uninterrupted distribution of fuel particles (surface or aerial) in a fuel bed that affects a fire's ability to sustain combustion and spread.

Fuel Loading – The volume of the available or burnable fuels in a specified area, usually expressed in tons per acre.

Fuel Treatment – Any manipulation or removal of fuels to reduce the likelihood of ignition and/or to lessen potential damage and resistance to control, including lopping, chipping, crushing, piling, and burning.

Fuels – The organic materials that would support the start and spread of a fire: duff, litter, grass, weeds, forbs, brush, trees, and dead woody materials.

Fuelwood – Material collected that is utilized for burning.

Group Selection – An uneven-aged silviculture method where trees are removed and new age classes are established in small groups.

Healthy Forests Restoration Act of 2003 – The Healthy Forests Restoration Act of 2003 (P.L. 108-148) contains a variety of provisions to expedite hazardous fuel reduction projects on specific types of Federal land that contain wildland urban interface, municipal watersheds, threatened and endangered species habitat that are at risk of wildland fire or insect and disease epidemics.

Heterogeneous – A complex mixture of multiple stands that are dissimilar from one another with both horizontal and vertical structure diversity across a landscape.

Homogeneous – A stand of trees in a contiguous area or across a landscape that have a common set of characteristics and similar forest structure.

Individual tree selection (free thinning) – The removal of individual trees based on project objectives.

Ladder Fuel – Fuels that bridge the gap between surface fuels and the tops, or crowns, of a tree.

Lopping and Scattering – Lopping logging debris and spreading it more or less evenly on the ground.

Mastication – The process of reducing larger woody slash and surface fuels into smaller material. Material is generally masticated in place with equipment.

Multiple Use – According to the Multiple-use Sustained-yield Act of 1960, multiple use is the management of all the various renewable surface resources of the National Forest System (NFS) so that they are utilized in the combination that would best meet the needs of the American people; such management makes the most judicious use of the land for some or all of these resources or related services over areas large enough to provide sufficient latitude for periodic adjustments in use to conform to changing needs and conditions. Some lands would be used for less than all of the resources. Harmonious and coordinated management of the various resources is employed, each with the other, without impairment of the productivity of the land. Consideration is given to the relative values of the various resources and not necessarily the combination of uses that would give the greatest dollar return or the greatest unit output.

Natural Fuels – Fuels resulting from natural processes and not directly generated or altered by land-management practices.

Natural Regeneration – The renewal of a tree crop by natural means without seeding or planting done by people. The new crop is grown from self-sown seed or by vegetative means, such as root suckers (i.e. aspen).

Objective – Concise statement of desired measurable results intended to promote achievement of specific goals. Attainment of objectives is limited by the application of standards and guidelines.

Patch Cutting – Clearcutting of small areas (less than 5 acres).

Pile Burn – A slash treatment where piles created by tree cutting operations are burned. Piles can be created by machine or by hand.

Prescribed Broadcast Burning – A fire ignited under specific conditions (prescriptions) and within established boundaries to achieve some land-management objective.

Products Other than Logs (POL) – Forest products such as posts, poles, and fiber from trees or parts of trees less than sawlog size. POL usually include trees greater than 5 inches diameter breast height (DBH) and less than 7.9 inches DBH, with tops of trees greater than 4 inches to less than 6 inches in diameter.

Reforestation – Re-establishment of a tree crop on forested land.

Retention – To keep the existing extent of a vegetative component (i.e old growth). Usually refers to a species (i.e. aspen).

Shade-tolerance – Species that have a tolerance to shading by other species. Shade tolerant species would grow and regenerate under a stand’s over-story.

Silvicultural System – A management process that tends, harvests, and replaces forests, resulting in a forest of distinctive form with a desired condition.

Silviculture – Generally, the science and art of tree management, based on the study of the life history and general characteristics of forest trees and stands, with particular reference to local factors; more particularly, the theory and practice of controlling the establishment, composition, constitution, and growth of forests for desired conditions.

Site Index – A measure of the relative productive capacity of an area for growing trees. Measurement is based on height of the dominant trees in a stand at a given age.

Slash – Fuels resulting from treatment activities, such as thinning, and natural events, such as wind, insects, or disease. Slash can consist of branches, tree tops, logs, and broken or uprooted trees.

Stand Replacing Fire – A fire that kills all or most living overstory trees in a forest and initiates secondary succession or regrowth.

Stocking – An indication of growing space occupancy relative to a pre-established standard, such as basal area or trees per acre.

Structural Stages – Any of several developmental stages of tree stands described in terms of tree size and the extent of canopy closure they create. They include

- **Structural Stage 1 (Grass/Forb) –** An early forest successional stage where grasses and forbs are the dominant vegetation and tree cover is less than one percent.
- **Structural Stage 2 (Shrubs/Seedlings) –** Developmental stage dominated by tree seedlings (less than one inch DBH) and shrub species.
- **Structural Stage 3 (Sapling/Pole) –** Developmental stage dominated by young trees 1 to 7 inches DBH, 10 to 50 feet tall, and usually less than 50 years old. This stage is subdivided into three canopy closure classes: A (less than 40 percent); B (40 to 70 percent); and C (greater than 70 percent).
- **Structural Stage 4 (Mature) –** Consists of trees larger and older than structural stage 3. Also classified by the same canopy closure categories as structural stage 3.

Successional Stages – The relatively transitory communities that replace one another during development toward a potential natural community.

Surface Fuels – Fuel on the surface of the ground, consisting of needle litter, dead branches, downed logs, and low growing plants.

Task Order – A supplemental document to a parent service/stewardship contract that directs the work to be completed by a contractor.

Thinning – A treatment where individual trees are cut to reduce stand density of trees primarily to improve growth, enhance forest health, or recover potential mortality.

Timber – A general term applied to tree stands that provide a wood-fiber product.

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.

Wildland Urban Interface (WUI) – As defined by the HFRA, Title I, Section 101, (16), the term "wildland urban interface" means:

(A) an area within or adjacent to an at-risk community that is identified in recommendations to the Secretary in a community wildfire protection plan; or

(B) in the case of any area for which a community wildfire protection plan is not in effect:

(i) an area extending ½ mile from the boundary of an at-risk community;

(ii)an area within 1 and 1/2 miles of the boundary of an at-risk community, including any land that:

(I) has a sustained steep slope that creates the potential for wildfire behavior endangering the at-risk community;

(II) has a geographic feature that aids in creating an effective fire break, such as a road or ridge top; or

(III) is in condition class 3, as documented by the Secretary in the project-specific environmental analysis; and

(iii) an area that is adjacent to an evacuation route for an at-risk community that the Secretary determines, in cooperation with the at-risk community, requires hazardous fuel reduction to provide safer evacuation from the at-risk community.

Uneven-aged - Forest stand composed of intermingling of trees that differ markedly in age (Avery and Burkhart 2002)

Upper Diameter Limit (UDL) – The diameter where the 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.

Appendix B Treatment Descriptions

Alternative 1

Mixed Conifer Stands

There are 971 acres mapped[1] as Douglas-fir mixed conifer treatment, 392 acres as ponderosa pine mixed conifer treatment, 42 acres as old growth mixed conifer treatment, and 44 acres as 2-staged mixed conifer treatment (**Error! Reference source not found.**). Treatment prescription in units designated as mixed conifer would be as follows:

- Thin to reduce the stand density by no more than 40% in any given unit, including old growth development areas, from the existing volume or basal area.
- Areas designated as inventoried and retention old growth would have the density reduced by no more than 30%, from the existing volume or basal area.
- All limber pine that do not pose a safety hazard, would be retained.
- All trees 16 inches diameter at breast height (DBH) and larger would be retained.
- Treatment could be done mechanically or manually.

Treatment prescription in Unit 74 is designated as a 2-staged mixed conifer treatment. This unit consists of Douglas-fir dominated stands with heavy downed surface fuels resulting from past disturbances. Because there is heavy fuel loading in the unit, two separate treatments would be performed as described below:

- Stage 1 – Existing downed fuels would be hand piled and later burned. Due to the density of these stands, some live conifers up to 16 inches DBH may be cut and piled with the existing slash in order to establish openings and minimize the scorching of adjacent trees for pile burning.

- Stage 2 – Thin to reduce the stand density by no more than 40% from the existing volume or basal area while incorporating the spatial arrangement mentioned above. All limber pine that do not pose a safety hazard, would be retained. All trees 16 inches DBH and larger would be retained. Treatment could be done mechanically or manually.

Lodgepole Pine Stands

There are 1,482 acres mapped for lodgepole pine treatment. Up to 50% of the mapped acres (741 acres) would be patchcut/clearcut. Treatment prescription in units designated as patchcut/clearcut would be as follows:

- Patchcuts (removal of all conifer trees) could be 1-5 acres in size.
- Clearcuts (removal of all conifer trees) could be 5-20 acres in size.
- No more than 50% of a unit would be patchcut or clearcut.
- Untreated buffers of at least 100 feet would be left between patchcuts and clearcuts.
- Mixed conifer species may be retained in patchcuts or clearcuts if there is minimal potential for blowdown when the remainder of the stand is cut.
- Following patchcut/clearcut treatments, reforestation treatments (tree planting of mixed conifer species) would occur in these areas.
- Treatment could be done mechanically or manually.

[1] Acres were derived by GIS query and are referred to as mapped acres in this document. Exact acreage treated is verified on the ground prior to implementation.

There are 17 acres of lodgepole pine mapped as regeneration thin. Treatment prescription in units designated as regeneration thin (areas previously patchcut/clearcut with trees less than 15 feet tall) would be as follows:

- Thin regenerated lodgepole pine to an average spacing of 10-15 feet.
- Treatment could be done mechanically or manually.

Aspen Stands

There are 231 acres mapped as aspen. Treatment prescription in units designated as aspen restoration would be as follows:

- Cut all conifers, except ponderosa pine 16 inches DBH and greater, within and up to 50 feet of the edge of the aspen clone.
- Retain all limber pine.
- If snags are not available in the aspen stand, create snags within the aspen stand by girdling up to five of the largest conifers less than 16 inches DBH, unless they would pose a safety hazard.
- Treatment could be done mechanically or manually.

Meadows and Shrublands

There are 45 acres mapped as meadow/shrubland. Treatment prescription in units designated as meadow/shrubland restoration would be as follows:

- Cut all ponderosa pine and Douglas-fir up to 14 inches DBH and all lodgepole pine up to 12 inches DBH.
- Retain all limber pine.
- Treatment would be done manually.

Defensible Space

Defensible space is delineated along areas where private property abuts NFS lands, except areas where proposed treatment units are located. Defensible space treatment would not occur in units proposed for different treatment along the private property boundary. Areas where proposed treatment units on NFS lands are not along the private property boundaries, defensible space prescriptions may be applied on NFS lands up to 300 feet from a structure, with an approved permit, to complement defensible space treatments on private property.

There are 2,032 acres mapped as defensible space throughout the project area. It is estimated that only a portion of those mapped acres, up to 10% or 203 acres, would be treated. Treatment could occur out to Zone 3 and follow the guidelines outlined by USFS resource specialists and in the Defensible Space Management Zones as described by the Colorado State Forest Service (CSFS 2012).

Non-Significant Forest Plan Amendment

Forest Plan Standard 2 under Management Area 3.5 requires the USFS to *Maintain or increase habitat effectiveness, except where new access is required by law* (Forest Plan, pg. 359). The proposed action would not maintain or increase effective habitat as required therefore, a non-significant Forest Plan Amendment would be needed to remove the applicability of this standard within the Forsythe II project boundary.

Alternative 2

Mixed Conifer Stands

There are 796 acres mapped[2] as Douglas-fir mixed conifer treatment, 293 acres as ponderosa pine mixed conifer treatment, 8 acres as old growth mixed conifer treatment, and 44 acres as 2-staged mixed conifer treatment (**Error! Reference source not found.**). Treatment prescription in these units would be as follows:

- Thin to reduce the stand density by no more than 50% in ponderosa pine dominated units, from the existing volume or basal area.
- Thin to reduce the stand density by no more than 40% in Douglas-fir dominated units, from the existing volume or basal area.
- Areas designated as inventoried and retention old growth would have the density reduced by no more than 30%, from the existing volume or basal.
- All limber pine that do not pose a safety hazard, would be retained.
- All trees 14 inches DBH and larger would be retained.
- Treatment could be done mechanically or manually.

Treatment prescription in Unit 74 is designated as a 2-staged mixed conifer treatment. This unit consists of Douglas-fir dominated stands with heavy downed surface fuels resulting from past disturbances. Because there is heavy fuel loading in the unit, two separate treatments would be performed as described below:

- Stage 1 – Existing downed fuels would be hand piled and later burned. Due to the density of these stands, some live conifers up to 14 inches DBH may be cut and piled with the existing slash in order to establish openings and minimize the scorching of adjacent trees for pile burning.

- Stage 2 – Thin to reduce the stand density by no more than 40% from the existing volume or basal area while incorporating the spatial arrangement mentioned above. All limber pine that do not pose a safety hazard, would be retained. All trees 14 inches DBH and larger would be retained. Treatment could be done mechanically or manually.

Lodgepole Pine Stands

There are 1,028 acres mapped as lodgepole pine treatment. Up to 30% of the mapped acres (308 acres) would be patchcut/clearcut. Treatment prescription in units designated as patchcut/clearcut would be as follows:

- Patchcuts (removal of all conifer trees) could be 1-5 acres in size.
- Clearcuts (removal of all conifer trees) could be 5-10 acres in size.
- No more than 30% of a unit would be patchcut or clearcut.
- Untreated buffers of at least 100 feet would be left between patchcuts and clearcuts.
- Mixed conifer species may be retained in patchcuts or clearcuts if there is minimal potential for blowdown when the remainder of the stand is cut.
- Following patchcut/clearcut treatments, reforestation treatments (tree planting of mixed conifer species) would occur in these areas.
- Treatment could be done mechanically or manually.

There are 8 acres of lodgepole pine mapped as regeneration thin. Treatment prescription in units designated as regeneration thin (areas previously patchcut/clearcut with trees less than 15 feet tall) would be as follows:

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[2] Acres were derived by GIS query and are referred to as mapped acres in this document. Exact acreage treated is verified on the ground prior to implementation.

- Thin regenerated lodgepole pine to an average spacing of 10-15 feet.
- Treatment could be done mechanically or manually.

Aspen Stands

There are 163 acres mapped as aspen. Treatment prescription in units designated as aspen restoration would be as follows:

- Cut all conifers, except ponderosa pine 14 inches DBH and greater, within and up to 10 feet of the edge of the aspen clone.
- Retain all limber pine.
- If snags are not available in the aspen stand, create snags within the aspen stand by girdling up to five of the largest conifers less than 14 inches DBH, unless they would pose a safety hazard.
- Treatment could be done mechanically or manually.

Meadows and Shrublands

There are 37 acres mapped as meadow/shrubland. Treatment prescription in units designated as meadow/shrubland restoration would be as follows:

- Cut all ponderosa pine and Douglas-fir up to 14 inches DBH and all lodgepole pine up to 14 inches DBH.
- Retain all limber pine.
- Treatment would be done manually.

Defensible Space

Defensible space is delineated along areas where private property abuts NFS lands, except areas where proposed treatment units are located. Defensible space treatment would not occur in proposed treatment units along the private property boundary. Areas where proposed treatment units on NFS lands are not along the private property boundaries, defensible space prescriptions would be applied on NFS lands up to 300 feet from a structure, with an approved permit, to complement defensible space treatments on private property.

There are 2,862 acres mapped as defensible space throughout the project area. It is estimated that only a portion of those mapped acres, up to 10% or 286 acres, would be treated. Treatment could occur out to Zone 3 and follow the guidelines outlined by USFS resource specialists and in the Defensible Space Management Zones as described by the Colorado State Forest Service (CSFS 2012).

Non-Significant Forest Plan Amendment

Forest Plan Standard 2 under Management Area 3.5 requires the USFS to *Maintain or increase habitat effectiveness, except where new access is required by law* (Forest Plan, pg. 359). Alternative 2 would not maintain or increase effective habitat as required therefore, a non-significant Forest Plan Amendment would be needed to remove the applicability of this standard within the Forsythe II project boundary.

Alternative 3

Mixed Conifer Stands

There are 885 acres mapped[3] as Douglas-fir mixed conifer treatment, 370 acres as ponderosa pine mixed conifer treatment, 42 acres as old growth mixed conifer treatment, and 61 acres as thin from below treatment. Treatment prescription in these units would be as follows:

- Thin to reduce the stand density by no more than 40% in any given unit, including old growth development areas, from the existing volume or basal area.
- Areas designated as inventoried and retention old growth would have the density reduced by no more than 30%, from the existing volume or basal area.
- All limber pine that do not pose a safety hazard, would be retained.
- All trees 16 inches DBH and larger would be retained.
- Unit 109 would be thinned from below to a diameter limit of 5 inches DBH and less
- Treatment could be done mechanically or manually.

Lodgepole Pine Stands

There are 765 acres mapped as lodgepole pine treatment. Up to 50% of the mapped acres (383 acres) would be patchcut/clearcut. Treatment prescription in units designated as patchcut/clearcut would be as follows:

- Patchcuts (removal of all conifer trees) could be 1-5 acres in size.
- Clearcuts (removal of all conifer trees) could be 5-20 acres in size.
- No more than 50% of a unit would be patchcut or clearcut.
- Untreated buffers of at least 100 feet would be left between patchcuts and clearcuts.
- Mixed conifer species may be retained in patchcuts or clearcuts if there is minimal potential for blowdown when the remainder of the stand is cut.
- Following patchcut/clearcut treatments, reforestation treatments (tree planting of mixed conifer species) would occur in these areas.
- Treatment could be done mechanically or manually.

There are 17 acres of lodgepole pine mapped as regeneration thin (**Error! Reference source not found.**). Treatment prescription in units designated as regeneration thin (areas previously patchcut/clearcut with trees less than 15 feet tall) would be as follows:

- Thin regenerated lodgepole pine to an average spacing of 10-15 feet.
- Treatment could be done mechanically or manually.

Aspen Stands

There are 255 acres mapped as aspen. Treatment prescription in units designated as aspen restoration would be as follows:

- Cut all conifers, except ponderosa pine 16 inches DBH and greater, within and up to 50 feet of the edge of the aspen clone.
- Retain all limber pine.
- If snags are not available in the aspen stand, create snags within the aspen stand by girdling up to five of the largest conifers less than 16 inches DBH, unless they would pose a safety hazard.

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[3] Acres were derived by GIS query and are referred to as mapped acres in this document. Exact acreage treated is verified on the ground prior to implementation.

- Treatment could be done mechanically or manually.

Meadows and Shrublands

There are 32 acres mapped as meadow/shrubland. Treatment prescription in units designated as meadow/shrubland restoration would be as follows:

- Cut all ponderosa pine and Douglas-fir up to 14 inches DBH and all lodgepole pine up to 12 inches DBH.
- Retain all limber pine.
- Treatment would be done manually.

Defensible Space

Defensible space is delineated along areas where private property abuts NFS lands, except areas where proposed treatment units are located. Defensible space treatment would not occur in proposed treatment units along the private property boundary. Areas where proposed treatment units on NFS lands are not along the private property boundaries, defensible space prescriptions would be applied on NFS lands up to 300 feet from a structure, with an approved permit, to complement defensible space treatments on private property.

There are 2,862 acres mapped as defensible space throughout the project area. It is estimated that only a portion of those mapped acres, up to 10% or 286 acres, would be treated. Treatment could occur out to Zone 3 and follow the guidelines outlined by USFS resource specialists and in the Defensible Space Management Zones as described by the Colorado State Forest Service (CSFS 2012).

Non-Significant Forest Plan Amendment

Forest Plan Standard 2 under Management Area 3.5 requires the USFS to *Maintain or increase habitat effectiveness, except where new access is required by law* (Forest Plan, pg. 359). Alternative 3 would not maintain or increase effective habitat as required therefore, a non-significant Forest Plan Amendment would be needed to remove the applicability of this standard within the Forsythe II project boundary.

Alternative 4

Mixed Conifer Stands

There are 971 acres mapped[4] as Douglas-fir mixed conifer treatment, 392 acres as ponderosa pine mixed conifer treatment, 42 acres as old growth mixed conifer treatment, and 44 acres as 2-staged mixed conifer treatment. Treatment prescription in units designated as mixed conifer would be as follows:

- Thin to reduce the stand density by no more than 40% in any given unit, including old growth development areas, from the existing volume or basal area.
- Areas designated as inventoried and retention old growth would have the density reduced by no more than 30%, from the existing volume or basal.
- All limber pine that do not pose a safety hazard, would be retained.
- All trees 12 inches DBH and larger would be retained.
- Treatment would be done manually.

[4] Acres were derived by GIS query and are referred to as mapped acres in this document. Exact acreage treated is verified on the ground prior to implementation.

Treatment prescription in Unit 74 is designated as a 2-staged mixed conifer treatment. This unit consists of Douglas-fir dominated stands with heavy downed surface fuels resulting from past disturbances. Because there is heavy fuel loading in the unit, two separate treatments would be performed as described below:

- Stage 1 – Existing downed fuels would be hand piled and later burned. Due to the density of these stands, some live conifers up to 16 inches DBH may be cut and piled with the existing slash in order to establish openings and minimize the scorching of adjacent trees for pile burning.

- Stage 2 – Thin to reduce the stand density by no more than 40% from the existing volume or basal area while incorporating the spatial arrangement mentioned above. All limber pine that do not pose a safety hazard, would be retained. All trees 16 inches DBH and larger would be retained. Treatment could be done mechanically or manually.

Lodgepole Pine Stands

There are 1,482 acres mapped as lodgepole pine treatment. Up to 30% of the mapped acres (445 acres) would be patchcut. Treatment prescription in units designated as patchcut would be as follows:

- Patchcuts (removal of all conifer trees) could be 1-5 acres in size.
- No more than 30% of a unit would be patchcut.
- Untreated buffers of at least 100 feet would be left between patchcuts and clearcuts.
- Mixed conifer species may be retained in patchcuts or clearcuts if there is minimal potential for blowdown when the remainder of the stand is cut.
- Following treatment, plant patchcut/clearcut areas with mixture of conifer species.
- Treatment could be done mechanically or manually.

There are 17 acres of lodgepole pine mapped as regeneration thin. Treatment prescription in units designated as regeneration thin (areas previously patchcut/clearcut with trees less than 15 feet tall) would be as follows:

- Thin regenerated lodgepole pine to an average spacing of 10-15 feet.
- Treatment would be done manually.

Aspen Stands

There are 231 acres mapped as aspen. Treatment prescription in units designated as aspen restoration would be as follows:

- Cut all conifers, except ponderosa pine 12 inches DBH and greater, within and up to 50 feet of the edge of the aspen clone.
- Retain all limber pine.
- If snags are not available in the aspen stand, create snags within the aspen stand by girdling up to five of the largest conifers less than 12 inches DBH, unless they would pose a safety hazard.
- Treatment would be done manually.

Meadows and Shrublands

There are 45 acres mapped as meadow/shrubland. Treatment prescription in units designated as meadow/shrubland restoration would be as follows:

- Cut all ponderosa pine, lodgepole pine, and Douglas-fir up to 12 inches DBH
- Retain all limber pine.
- Treatment would be done manually.

Defensible Space

Defensible space is delineated along areas where private property abuts NFS lands, except areas where proposed treatment units are located. Defensible space treatment would not occur in proposed treatment units along the private property boundary. Areas where proposed treatment units on NFS lands are not along the private property boundaries, defensible space prescriptions would be applied on NFS lands up to 100 feet from a structure, with an approved permit, to complement defensible space treatments on private property.

There are 878 acres mapped as defensible space throughout the project area. It is estimated that only a portion of those mapped acres, up to 10% or 88 acres, would be treated. Treatment could occur out to Zone 2 and follow the guidelines outlined by USFS resource specialists and in the Defensible Space Management Zones as described by the Colorado State Forest Service (CSFS 2012).

Non-Significant Forest Plan Amendment

Forest Plan Standard 2 under Management Area 3.5 requires the USFS to *Maintain or increase habitat effectiveness, except where new access is required by law* (Forest Plan, pg. 359). Alternative 4 would not maintain or increase effective habitat as required therefore, a non-significant Forest Plan Amendment would be needed to remove the applicability of this standard within the Forsythe II project boundary.

Broadcast Burn (Prescribed Fire)

Prescribed fire (pile burning, underburning, broadcast burning, etc.) would be used as a fuels reduction treatment and as a tool to restore natural processes. Activity piles generated from hand and mechanical prescriptions would be burned.

Underburning involves the burning of stands by aerial ignition or by drip torch, under prescribed conditions. Underburning within the project area would mimic the low- and mixed-intensity fires (including patches of high-intensity fire) naturally found in the mixed conifer zone. Prescribed fire would be applied following manual and mechanical treatments within the identified units. Where there are no existing control lines (e.g. roads, natural barriers such as wet drainages), firelines would be constructed by hand. Handlines would involve scraping down to mineral soil and constructing waterbars for erosion control.

Jackpot burning would occur in meadow restoration treatments by igniting concentrations of fuels on the ground and burning small trees in jackpot piles. Broadcast burning would be considered for the purpose of stimulating aspen and limiting conifer encroachment.

Appendix C – Forest Pests and Diseases of Concern

Forest pests and disease of concern are listed in alphabetical order, below. These pests and diseases are primarily of concern when they reach levels beyond the natural range. Excessive tree densities are a cause for concern, as reduced individual tree vigor allows many pests and diseases to prosper. Forest pests and diseases are natural regulating agents and become a primary concern when they cause larger effects than are considered acceptable. Large scale die-off or mortality from forest pests or diseases can create fuels conditions that have the potential to create catastrophic wildland fire. Another cause for concern is excessive damage created by forest pests and diseases that reduces their commercial value. The species below are not inclusive of all pests or diseases that might affect the project area, but rather the ones listed are those that can have un-desirable effects.

This section details tree species affected that are present in the project area (the pests may affect species other than those listed, however only those tree species in the project area are listed). The management options are addressed and come directly from *Field Guide to Diseases & Insects of the Rocky Mountain Region* Rocky Mountain Region, Forest Health Protection 2010. Other information regarding these pests and diseases is available in that publication, as well as numerous others. This report is intended to address management options as this information would assist the Deciding Official and managers. In most cases, wording is directly from the above mentioned publication, with minor changes. The tense for this section is inconsistent with the rest of the document, and is in present tense. This is to maintain consistency with the publication from where the management options were taken, and to avoid confusion in reading.

Identification of the forest pests and disease in this section requires some training, and so field personnel implementing prescriptive management recommendations should be trained to identify specific diseases so management recommendations can be implemented.

Cankers (*Cytospora chrysosperma*)

Species affected: Aspen

Significance: Mortality is the major impact of Cytospora canker. Although stress usually precedes severe infection, disease impact can be substantial because trees may recover from stress in the absence of the canker. The canker also impact regenerating stands.

Management options: Avoiding wounds and stress would reduce the likelihood of Cytospora canker in individual trees. Clearcutting, prescribed fire, or wildfire would stimulate regeneration and would give the best chances for maintaining aspen on the site.

Dwarf mistletoes (*Arceuthobium* spp.)

Species affected: Ponderosa pine, Douglas fir, lodgepole pine and limber pine

Significance: Dwarf mistletoes are parasitic plants of conifers that obtain almost all their needs, including water, mineral, and carbon nutrients, from their hosts. In Colorado and throughout much of the West, dwarf mistletoes are considered among the most damaging forest disease agents. Mortality, growth reduction, poor wood quality, reduced seed production and hazardous trees are the consequences of infected forest stands. Infected trees and stands are also predisposed to insect infestation, especially bark beetles and other diseases, particularly during periods of drought or other tree stress.

Management options: The first step when making management decisions in stands infected with dwarf mistletoe is to quantify the incidence and severity of infection. Dwarf mistletoes are obligate parasites. Therefore, the mistletoe dies when the infected part of the host dies or is removed. In the forest various combinations of harvesting of infected trees, thinning, favoring non-susceptible hosts, and pruning have been used to reduce losses from dwarf mistletoes. Eradication of the pest is not necessary. Keeping the disease at low to moderate levels in the forest is usually enough to prevent unacceptable damage. Highly valued trees, or trees in high use areas, would require greater levels of management to reduce loss or to minimize hazards

Mountain Pine Beetle (Dendroctonus ponderosae)

Species affected: ponderosa pine, lodgepole pine, and limber pine

Significance: Mountain Pine Beetle is the principal insect pest of mature and overmature ponderosa pine, lodgepole pine, and limber pine, although younger trees, from 4 to 5 inches in diameter can be killed. Mountain Pine Beetle typically colonizes trees weakened by lightning, fire, wind and drought. Outbreaks of this bark beetle can kill millions of trees covering many hectares.

Management options: As with other species of bark beetles, removal of trees weakened by drought, competition, dwarf mistletoe, root disease, fire and wind before infestation by Mountain Pine Beetle would lower the risk of high-level tree mortality. Removing infested trees before emergence of this bark beetle in June may lower the risk of future infestations. Insecticides can be applied to the bark of highly valued trees to prevent infestation.

Pine Engraver (Ips pini)

Species affected: ponderosa pine

Significance: At outbreak levels, the Pine Engraver can cause considerable tree mortality and, thus, it is an important pest in timber-producing regions. Outbreaks are usually shot-lived, not lasting more than one year, although outbreaks have been known to last two to three years during periods of extreme drought.

Population densities of this engraver beetle can increase in logging debris, leading to the infestation of nearby living trees. Trees with tops killed by Pine Engraver are often subsequently killed by Western Pine Beetle, *D. brevicomis* or Mountain Pine Beetle, *D. ponderosae*.

Management options: Cut and scatter branches from treetops remaining after logging. Exposure to the sun would kill broods beneath the bark. Insecticides can be applied to the bark of highly valued trees to prevent infestation.

Spruce Beetle (Dendroctonus rufipennis)

Species affected: Engelmann spruce and blue spruce

Significance: The spruce beetle is the most significant natural mortality agent of mature spruce. Outbreaks cause extensive tree mortality and can alter stand structure and composition.

Management options: Remove spruce infested trees. These activities should be designed in order to minimize future windthrow potential. Following windthrow events, remove windthrown spruce after beetle colonization and before brood beetles develop and exit.

Western Gall Rust (Peridemium harknessii)

Species affected: Ponderosa pine and lodgepole pine

Significance: Western gall rust affects trees of all ages, causing growth loss, branch death, and deformity. Mortality is most common in seedlings and saplings because galls can quickly girdle the small stem. Branch galls typically only live a few years until the branch and the gall die. Mortality may result when numerous branch galls occur throughout the crown.

Management Options: Management of western gall rust is complicated because of the lag time between infection and symptom development. Treatments to reduce impacts are sanitation, pruning, prepare for disease losses, manage species, or destroy and regenerate.

White Pine Blister Rust (Cronartium ribicola)

Species affected: limber pine

Significance: White pine blister rust is the most damaging disease of pines and has cost more to control than any other forest disease in North America. In California alone, millions of trees are damaged or killed each year, and millions of dollars have been spend, probably fruitlessly, on control through eradication of *Ribes* spp. Small trees are particularly vulnerable: only a few branch infections or a single trunk infection can result in tree death. Larger infected trees can also be severely weakened and eventually die or are killed by bark beetles.

Management options: *Ribes* spp. Eradication has been discontinued as an effective method of controlling blister rust. Growth of nonhost species on high rust hazard sites is encouraged. Current research and development of rust-resistant pines may lead to a valuable management option in the near future

**White pine blister rust has not been detected in the project area. This Blister rust has 4 life stages and requires ideal conditions to pass between the host (sugar pine) and alternate host (*Ribes*, *Castilleja*). Due to the lack of moist drainages and low humidity, the life cycles may not be able to be completed under the conditions present in the Breckenridge project area. Humidity and temperature requirements are very specific for the basidiospore stage and basidiospores do not travel far. The basidiospore is the diploid stage of White Pine Blister Rust, and so if this cycle is not complete, 'infection' does not occur. Lack of an alternate host in close proximity to ideal basidiospore production conditions (drainages, north facing slopes) may be why White Pine Blister Rust is has not been observed in the project area.

Appendix D – Forest Plan Direction

Forest Plan Definitions:

Standards are defined as courses of action or levels of attainment required to achieve goals and objectives. Standards are mandatory and deviation from them is not permissible without an amendment to the *Forest Plan*. Standards are developed (1) when laws or policies do not exist or benefit from further clarification, (2) when standards are critical to objectives, and (3) when unacceptable impacts are expected if a standard were not in place.

Guidelines are defined as preferred or advisable courses of action or levels of attainment designed to achieve the goals and objectives. When deviation from a guideline is necessary, it would be documented during the project-level analysis. Under those circumstances, the responsible official should recognize the purpose(s) for which the guideline was developed and assure interested individuals that any subsequently approved actions are not in conflict with the purposes for which the guideline was developed. Guidelines are developed in the following circumstances: (1) when they contribute to achievement of goals; (2) in response to variable site conditions; (3) in response to variable overall conditions; and (4) when professional expertise is needed.

Goals describe desired end-results and are normally expressed in broad, general terms. *Forest Plan* goals link broad agency goals as set forth by law, executive order, regulation, agency directives and the Resource Planning Act (RPA) program. These goals also closely reflect the Regional Goals described in the *Rocky Mountain Regional Guide* (1992).

Objectives are concise statements of measurable, desired results intended to promote achievement of *Forest Plan* goals. Objectives describe (1) desired resource conditions in the area covered by the *Plan*, either in the next decade or longer, and (2) desired levels of goods and services that the *Plan* is capable of producing in the next decade.

Forest Plan Standards

Water Resources

ST # 7 – In the water influence zone next to perennial and intermittent streams, lakes and wetlands, allow only those land treatments that maintain or improve long-term stream health.

ST # 8 – In watersheds containing aquatic TES species, allow activities and uses within 300 feet or the top of the inner gorge (whichever is greatest), of perennial and intermittent streams, wetlands, and lakes (over 1 acre) only if onsite analysis shows that long-term hydrologic function, channel stability, and stream health would be maintained or improved.

ST # 9 - Design and construct all stream crossings and other in-stream structures to pass normal flows, withstand expected flood flows, and allow free movement of resident aquatic life.

ST # 10 – Conduct actions so that stream pattern, geometry, and habitats are maintained or improved toward robust stream health.

ST# 11– Do not degrade ground cover, soil structure, water budgets, and drainage patterns in wetlands.

ST# 16 – Construct roads and other disturbed sites to minimize sediment discharge into streams, lakes and wetlands.

ST# 18 – Reclaim roads and other disturbed sites when use ends, as needed, to prevent resource damage.

Biodiversity

ST # 50 – Manage activities to avoid disturbance to sensitive species, which would result in a trend toward federal listing or loss of population viability. The protection would vary depending on the species, the potential for disturbance, topography, location of important habitat components, and other pertinent factors. Special attention would be given during breeding, young rearing, and other times, which are critical to survival of both flora and fauna.

ST # 51 – Close areas to activities to avoid disturbing threatened, endangered, and proposed species during breeding, young rearing, or at other times critical to survival. Exceptions may occur when individuals are adapted to human activity, or the activities are not considered a threat.

Silviculture/Timber

ST # 56 – Develop prescriptions prior to timber harvest to identify the amount, size(s) and distribution of down logs and snags to be left on-site, as well as live, green replacement trees for future snags. On Forest sites, snags and course woody debris should be retained (where materials are available) in accordance with the average minimums specified in Table 1.8 (of Forest Plan).

ST #57 –Limited timber cutting on unsuitable or tentatively suitable and not available lands, may occur for such purposes as salvage, protection or enhancement of biodiversity or wildlife habitat…Regulated timber-harvest activities would occur on only those lands classified as suitable and available for timber production as shown on the timber suitability map (of Forest Plan).

ST # 59 – The requirement for adequate restocking within five years is initiated by the final harvest. Five years after final harvest means five years after clearcutting, five years after the final overstory removal in the shelterwood and seedtree methods, or five years after selection cutting. The timing of first and third year restocking surveys is initiated by the reforestation treatment.

ST # 63 – Forty acres is the maximum allowable opening acreage for forest types. Exceptions to this maximum are provided at 36 CFR 219.27(d)(2)(I) through (iii). The regulations at 36 219.27(d)(2)(ii allow for size limits exceeding those established at 36 CFR (219.27(d)(2) and 36 CFR 219.27(d)(2)(I). Exceptions are permitted for individual timber sales after 60 day public notice and review by the Regional Forester. The regulations at 36 CFR 219.27(d)(2)(iii) provide that the established limit shall not apply to the size of areas harvested as a result of natural catastrophic conditions such as fire, insect and disease attack, or windstorm.

ST # 65 – Retain large woody debris on harvested or thinned sites to help retain moisture, trap soil movement, provide microsites for establishment of forbs, grasses, shrubs, and trees, and to provide habitat for wildlife.

ST # 66 – The size of the uncut forest areas between openings must be based on the management objectives for the landscape unit being analyzed. If these objectives include creating a mix of vegetation types to benefit the kinds of wildlife associated with early successional stages and edges, the size of uncut units can be small. For the late succession-associated species, the uncut units should be large enough to function as an ecological system not overly influenced by the edge.

ST # 67 – Where disease can be spread from an uncut stand to a newly regenerated stand, it is desirable to cut the adjacent infected stand before the regenerated stand reaches a height of six feet.

ST # 68 – Provide dead trees and live replacements to support primary cavity excavators (woodpeckers) at or above 50 percent of their biological potential.

Wildlife

ST # 96 – Restrict seasonal use of travel ways (under FS jurisdiction) to reduce disturbance in sensitive big game areas such as birthing areas and winter range…"

ST # 97 – Structures, such as fences, roads, and canals, would be designed and built so that they do no create unreasonable or unnecessary movement barriers or hazards for wildlife.

ST # 99 – In riparian areas, cover that provides wildlife travel corridors would be maintained along the entire length of riparian zones on at least one side of the drainage. New corridor interruptions affecting both sides of the drainage would be of minimum width needed and no more than 60 feet.

ST # 101 - Protect known raptor nest areas. Base the extent of protection on proposed management activities, human activities existing before nest establishment, species, topography, vegetative cover, and other factors. A no-disturbance buffer around active nest sites would be required from nest site selection to fledgling (generally March through July). Exceptions may occur when individuals are adapted to human activity.

Management area 3.5 Forested Flora and Fauna Habitats:

ST # 1 – Exclude vegetation treatment of inventoried spruce-fir or lodgepole pine old growth.

ST # 2 – Maintain or increase habitat effectiveness, except where new access is required by law.

ST # 3 – Discourage or prohibit human activities and travel, where needed, to allow effective habitat use during season of primary use by elk, deer and bighorn sheep (at least the minimum periods of May 15 through June 30 for elk calving, June 1 through June 30 for deer fawning, May 15 through June 30 for bighorn lambing, and December 1 through March 31 for wintering deer, elk and bighorn).
ST # 4 – Discourage or prohibit human activities and travel, where needed, to allow effective habitat use by other wildlife species, especially during the seasons of birthing and rearing of young.
ST # 5 – Do not construct new roads except when they contribute to improving habitat or providing legal access. Obliterate any temporary roads within one year following intended use.
GL # 7 – Allow, through vegetation protection, or encourage, through vegetation treatments, the development of future lodgepole pine and spruce-fir old-growth conditions.

Forest Plan Guidelines

Biodiversity

GL #37– Maintain aspen, even at the expense of spruce-fir or other late-successional stands.

GL #40 – Protect landscape linkage areas (pattered matrix, corridors, stepping stones, etc.) which facilitate multidirectional movement of species between important habitats such as late-successional forests, high elevation tundra, meadows and forests, lower elevation forests, shrublands, and prairies.

GL #41 – Protect communities of special concern such as talus slopes, caves, springs, seeps, wetlands, aquatic habitats, short-grass prairies, late successional forests, and alpine tundra (including the ecotone and sufficient buffer areas).

GL #41 – When managing vegetation, maintain edge contrasts and edge-to-interior ratios which mimic edge conditions that would result from natural disturbance regimes (fire, insect and disease infestations.)

GL # 43 – When managing vegetation, maintain edge contrasts and edge-to-interior ratios which mimic edge conditions that would result from natural disturbance regimes (fire, insect and disease infestations).

Silviculture/Timber

GL # 68 –Provide dead trees and live replacements to support primary cavity excavators (woodpeckers) at or above 50% of their biological potential.

GL # 69 – Do not undertake regeneration harvests of even-aged timber stands (sites) until the stands have generally reached or surpassed 95 percent of the culmination of the mean annual increment measured in cubic feet. Exceptions may be made where resource-management objectives or special resource considerations require earlier harvest, such as:

a. stands which are in imminent danger from insect or disease attacks
b. wildlife habitat improvement
c. visual resource enhancement or rehabilitation
d. ecosystem restoration
e. areas managed for Christmas tree production

GL # 70 – Do not apply minimum or maximum size limits for stand acreages where an uneven-aged structure can be maintained throughout.

GL # 71 –Artificially created openings would no longer be considered openings when the trees in the opening have reached a height and density that meets the objectives and criteria established for the management area (See table 1.13 of Forest Plan).

GL # 73 – Apply silvicultural standards and guidelines at the watershed and landscape level, as well as to individual stands of trees to perpetuate a range of environmental conditions while supplying goods and services to people.

GL # 74 – In most circumstances, rely on or make primary use of those silvicultural systems which ensure regeneration of forest stands through natural seeding and suckering.

GL #75 – Use artificial methods when it is unreliable to count on the natural sequence of events and/or environmental conditions to regenerate the forests within five years.

GL # 76 –Except for treatments designed to enhance meadows, avoid altering more than one-third of the edge of a natural opening whenever an artificially created opening lies adjacent to a natural opening. Additional edge should not be created until previously treated areas are considered closed (meets regeneration standards), according to the standard listed in Table 1.10 (of Forest Plan).

GL # 78 –Where appropriate, reduce competition between desired trees and other vegetation.

Wildlife

GL # 92 – Selected Management Indicator Communities for animals and plants would include: existing and developing old growth forests; interior forests; young to mature forest structural stages; openings within and adjacent to forests; aspen forests; montane and prairie riparian areas and wetlands; montane and prairie aquatic environments, short- grass prairie; mid-grass prairie; and prairie dog towns. In addition, caves and mines on the Forests and prairie woodlands on the Grassland are identified as specialized habitat types.

GL # 103 – Maintain the function of key or unique habitats such as primary feeding areas, winter ranges, riparian habitats, breeding areas, birthing areas, rearing areas, migration corridors, animal concentration areas, wooded draws, and riparian areas. Human disturbance should be minimized during periods critical for wildlife.

GL # 106 – Exclude human activity in key elk-calving areas during a minimum period of May 15 to June 15 and in key winter range of elk and deer for a minimum of December 1 through March 30 with the exception of through routes.

GL # 107 – Avoid disconnecting or severing intact areas of effective habitat with new open roads and trails. Favor seasonal use during non-critical times for wildlife when this cannot be avoided.

GL # 108 – When developing new open roads and trails, do not reduce contiguous areas of effective habitat to less than 250 acres or further reduce effective habitat of 20 to 250 acres in size, except where access is required by law.

GL # 109 – Additional open roads and trails should not reduce effective habitat below 50% by Geographic Area, or further reduce effective habitat in Geographic Areas that are already at or below 50% on NFS lands.

GL # 118 – Retain all existing Douglas-fir and ponderosa pine old growth and increase amounts in the future.

GL # 119 – Retain some connectivity of existing forested corridors within identified map areas, and between old-growth sites that are not planned for harvest, or manage for future forested corridors where connectivity is potential but absent.

GL # 120 – Maintain or increase habitat effectiveness within identified old growth areas and all old growth sites that are not planned for harvest.

GL # 121 – Within existing ponderosa pine and Douglas-fir old-growth stands that are known or discovered, either exclude vegetation treatments or reduce fire hazards using prescribed fire or mechanical means if sites are at risk from fire (e.g. removal of encroaching Douglas-fir regeneration in ponderosa pine old growth sites).

GL # 122 – Allow through vegetation protection, or encourage through vegetation treatments the development of future Douglas-fir and ponderosa pine old growth conditions within identified old-growth areas.

Fire

GL # 123 – When feasible and appropriate, use broadcast burning to dispose of slash, return the inorganic and organic chemicals in the foliage and small woody material to the soil, to reduce fire hazard, and to provide seed beds for natural regeneration.

Insects and Disease

GL # 124 – Plan management activities with consideration for potential insect or disease outbreaks. Design management to meet or enhance management area objectives.

GL # 125 – Use integrated pest management techniques, including silvicultural treatments, to meet management area objectives. Base treatment activities on values of, and risks to, wildlife habitat, adjacent private lands as well as public lands…

GL # 126 – Project plans should consider existing infestations of insects or disease within a project area. Design activities to minimize the risks of spreading the infestation while still providing habitat for those wildlife species dependent on the presence of insects and disease.

<u>Forest Plan Goals:</u>

Goal # 1 – Manage the Forests and Grassland to assure productive, healthy ecosystems, blending social, physical, economic, and biological needs and values.

Goal # 3 – In ponderosa pine and Douglas-fir forests, manage existing old growth and mature forests to retain and encourage old growth qualities.

Goal # 4 – Establish an upward trend for threatened, endangered, or sensitive plant and animal species, and maintain sensitive species through management activities that recognize TES habitat needs across all levels or scales.

Goal # 6– Activities that have the ability to affect the continuity of structure, composition, and function within riparian ecosystems shall be managed to sustain riparian areas.

Goal # 7 – Maintain or improve water quality, stream processes, channel stability, and aquatic management indicator species (MIS) habitats, and riparian resources, while providing for municipal and agricultural uses.

Goal # 8 – Provide a range of successional stages of community types across Forests and Grasslands landscapes that:

- Maintain ecosystem integrity
- Maintains or improves habitats for MIS
- Protects adjacent property values
- Reduces wildfire hazards
- Minimizes wildfire suppression costs

Goal # 34 – Maintain, and restore where necessary, the compositional, structural, and functional elements which would perpetuate diversity.

Goal # 38 – Establish or maintain landscape linkages, where needed and feasible, which provide connections among large, contiguous blocks of late-successional forest.

Goal # 39 – Maintain, and restore where necessary, habitats of sufficient area and appropriate spatial pattern, to minimize the adverse effects of human-caused fragmentation.

Goal #42 – Allow ecological processes where feasible at all temporal and spatial scales to proceed in a manner that contributes to sustainable wildland ecosystems.

Goal #44 – Restore, protect, and enhance habitats for threatened, endangered, and proposed flora and fauna species listed in accordance with the Endangered Species Act and sensitive species appearing on the regional sensitive species list to contribute to their stabilization and full recovery.

Goal # 45 – Habitats for federally-listed threatened, endangered, and proposed species and regionally-listed sensitive species are protected, restored, and enhanced. . .

Goal # 53 – When competing uses arise, favor habitat specialists that are characteristic of restricted niches present in rare or declining habitats, over species which are habitat generalists, characteristic of common or expanding habitats.

Goal # 95 – Retain the integrity of effective habitat areas.

Goal # 116 – Maintain or develop a network of existing and future old growth that provides adequate habitat which is well-dispersed, effective, and accessible to associated wildlife species.

Goal # 117 – Provide for the most rapid development of future Douglas-fir and ponderosa pine old growth conditions within identified areas.

Forest Plan Objectives:

Objective #2 – Manage acres of old growth and mature forests to retain or encourage development of old growth as shown in Table 1.1 (of Forest Plan).

Objective #11 – Reduce the number of high risk/high value, and high and moderate risk acres by 2,000 to 7,000 acres annually. Both mechanical and prescribed fire treatments may be used. See table 1.3 (of forest plan).

Objective # 12 – Manage acres of Forests and Grassland structural stages to obtain the range of stages shown in Tables 1.4 and 1.5 (of Forest Plan).