Forsythe Fuels Reduction Project
Environmental Assessment

USDA Forest Service
Roosevelt National Forest
Boulder Ranger District
Boulder, Colorado
### Commonly Used Acronyms and Abbreviations

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Forsythe Fuel Reduction Project
Environmental Assessment
Boulder and Gilpin Counties, Colorado

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Cooperating Agencies: None

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Abstract: The Boulder Ranger District of the Arapaho and Roosevelt National Forests and Pawnee National Grassland has prepared an Environmental Assessment (EA) in compliance with the National Environmental Policy Act (NEPA) and other relevant Federal and State laws and regulations. The Boulder Ranger District proposes to implement multiple resource management actions within the Forsythe Fuels Reduction Project Area as guided by the and Roosevelt National Forests and Pawnee National Grassland Land and Resource Management Plan (Forest Plan), the Healthy Forests Restoration Act (HFRA), the National Fire Plan, the Healthy Forest Initiative (HFI), and other National level policy. The focus of the proposed action is to manage the vegetation to reduce the threat to ecosystem components, including forest resources to large scale severe wildfires and the existing insect (mountain pine beetle) and disease epidemic through completing hazardous fuels reduction activities. Two alternatives are considered in detail. Alternative A is the No-Action Alternative. Alternative B is the proposed action (See map on page 31). It uses thinning in ponderosa pine and patch-cuts and group selections in lodgepole pine to break up large areas of continuous, dense forest and lower and wildfire hazard. Due to the current mountain pine beetle (MPB) epidemic, Alternative B also proposes sanitation and salvage activities in pine stands, which would occur based on the presence of MPB. Additionally due to the need for reducing fuels and restoring fire to the landscape, Alternative B proposes prescribed broadcast burning in specified areas. This EA discloses the direct, indirect, and cumulative environmental impacts resulting from the proposed action and alternatives.
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Chapter 1 – Introduction

Background

The Boulder Ranger District of the Arapaho and Roosevelt National Forest and Pawnee National Grassland proposes multiple treatments promoting healthier forests and watersheds creating a landscape more adaptable to fire and resistant to insects. The project area is located west of Gross Reservoir, approximately 6 miles west of Boulder, CO (see vicinity map. Reducing the fuel hazard condition on National Forest land combined with defensible space efforts on private lands has the potential to increase the effectiveness of both treatments thereby reducing losses from wildfire.

This 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 Fuel Reduction Project Environmental Assessment has been prepared. One of the many purposes of NEPA is to reduce agency paperwork and delay in analysis. Therefore, this Environmental Assessment (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). Referring to this document and the analysis completed for the Forest Plan, eliminates repetitive discussions of decisions that have been previously made. 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.

This project is authorized under the Healthy Forest Restoration Act (HFRA) and will therefore be subject to the objection procedure at 36 CFR 218, in lieu of the appeal procedure at 36 CFR 215. This process encourages early and continued public participation in the planning process prior to a decision being made.

This EA is not a decision document. Instead, it presents evidence and analysis necessary to determine whether the consequences of the proposed action have “significant” effects on the human environment and therefore, whether an EIS is necessary. Upon completion of this determination, the Responsible Official, District Ranger, would make a decision to implement the proposed action or an alternative.
Glossary of Terms

The following terms will be used throughout the document and, for the convenience of the reader; definitions are included at the beginning of the document rather than as an appendix.

**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.

**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 as a result of a wildland fire disturbance event.

**Basal Area:** The cross-sectional area of a stand of trees measured at breast height. The area is expressed in square feet per acre.

**Best Management Practices (BMPs)** Land management methods, measures, or practices intended to minimize or reduce water pollution. Usually BMPs are applied as a system of practices rather than a single practice. BMPs are selected on the basis of site-specific conditions that reflect natural background conditions and political, social, economic, and technical feasibility.

**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.

**Blackline:** Pre-burning of fuels adjacent to a control line before igniting a prescribed burn. Blacklining is usually done in heavy fuels adjacent to a control line during periods of low fire danger to reduce heat on holding crews and lessen chances for spotting across control lines.
Broadcast Burn (a type of prescribed fire): 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.

Burn Severity: Qualitative measure of the amount of heat released to the soil by the consumption of surface fuels and duff during a fire. Burn severity relates to soil heating, large fuel and duff consumption, consumption of the litter and organic layer beneath trees and isolated shrubs, and mortality of buried plant parts. Severity classes are measured as unburned, scorched, low severity, moderate severity, and high severity. A high severity burn would describe a condition in which most woody debris and the entire forest floor is consumed down to bare mineral soil. Soil may turn red due to extreme heat. Also, fine roots and organic matter are charred in the upper one-half inch of mineral soil.

Canopy, Canopy Closure (Canopy Cover), Canopy Layer:
- **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/Cover**: 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.

Cavity Nesting Species: Wildlife species that depend on cavities in trees for their shelter and/or nesting. These species include primary cavity nesters, such as woodpeckers, which excavate cavities in soft or decayed wood for nesting, and secondary cavity nesters that typically nest in natural cavities or those excavated by another species.

Chipping: The process of reducing larger woody slash into smaller material that is generally three inches and smaller. Material is generally brought to a chipping machine. Chips are then randomly scattered so as not to exceed three inches in depth.

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 within 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 will 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 the pine, spruce and juniper.

**Cost Effective:** Achieving specified outputs or objectives under given conditions for the least cost.

**Cost Efficient:** A comparative measure of economic efficiency determined by maximizing the present net worth or value of an alternative, subject to meeting the objectives of the alternative.

**Council on Environmental Quality (CEQ):** An advisory council to the President established by the National Environmental Policy Act (NEPA) of 1969.

**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 (Vegetation)** 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 Closure** (See "Canopy Cover.")

**Crown Density** The thickness both spatially in depth and in closeness of growth (compaction) 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.

**Designated road, trail, or area:** A National Forest System road, a National Forest System trail, or an area on National Forest System lands that is designated for motor vehicle use pursuant to § 212.51 on a motor vehicle use map.
Desired Future Condition, Desired Ecological 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 at Breast Height (DBH) The diameter of a standing tree at a point 4 feet, 6 inches from ground level.

Direct Effects Results of an action occurring when and where that action takes place.

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 (LRMP). This term is derived from the National Forest Management Act (NFMA). This term is not synonymous with "biological diversity."

Down and Dead Woody Material, Down Logs, Down Woody Material: Woody material from any source that is dead and lying on the forest floor.

Ecosystem: A community of living plants and animals interacting with each other and with their physical environment. A geographic area where it is meaningful to address the interrelationships with human social systems, sources of energy, and the ecological processes that shape change over time. The complex of a community of organisms and its environment functioning as an ecological unit in nature.

Eligible (Heritage Resources): Indicates a specific heritage resource qualifies for or is already listed in the National Register of Historic Places.

Endangered Species: Any species of animal or plant in danger of extinction throughout all or a significant portion of its range and so designated by the Secretary of Interior in accordance with the 1973 Endangered Species Act.

Ephemeral Streams: A stream or portion of a stream that flows briefly in direct response to precipitation in the immediate vicinity and whose channel is at all times above the water table. Ephemeral areas drain water to intermittent or perennial stream channels. Any sediment created by soil erosion during logging or road-building activities can be carried by way of the ephemeral, intermittent, and perennial stream channels to the watershed outlet. Ephemeral areas generally occur above the upper reaches of intermittent or perennial streams. Since they can direct water into intermittent or perennial stream channels, care should be taken to minimize disturbing soil in these areas.

Erosion The wearing away of the land surface by running water, wind, ice, gravity, or other geological activities.

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.

Fire Suppression: All the work and activities connected with fire-extinguishing operations beginning with discovery and continuing until the fire is completely extinguished.

Fiscal Year (FY): Within the Forest Service, the fiscal year includes October 1 to September 30. The fiscal year is referred to by the calendar year beginning January 1. For example, October 1, 2011, to September 30, 2012, is referred to as Fiscal Year 2012.

Forest road or trail: A road or trail wholly or partly within or adjacent to and serving the National Forest System that the Forest Service determines is necessary for the protection, administration, and utilization of the National Forest System and the use and development of its resources.

Forest transportation atlas: A display of the system of roads, trails, and airfields of an administrative unit.

Forest transportation facility: A forest road, trail, or an airfield that is displayed in a forest transportation atlas, including bridges, culverts, parking lots, marine access facilities, safety devices, and other improvements appurtenant to the forest transportation system.

Forest transportation system: The system of National Forest System roads, National Forest System trails, and airfields on National Forest System lands.

Fuel Breaks: Generally wide strips of land 60 to 1,000 feet in width on which native vegetation has been modified so that fires burning into them can be more readily controlled. Some fuel breaks contain fire lines such as roads 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 (synonym for fuel modification).

Fuels: The organic materials that will support the start and spread of a fire: duff, litter, grass, weeds, forbs, brush, trees, and dead woody materials.
**Fuelwood:** Round, split, or sawed wood cut into short lengths for burning as fuel. Also referred to as firewood.

**Group Selection:** 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.

**Herbaceous Fuels:** Grasses, forbs, and other plants that contain little woody tissue.

**Implementation:** Those activities necessary to initiate the actions in the approved land and resource management plan (LRMP).

**Indirect Effects:** Results of an action occurring at a location other than where the action takes place and/or later in time but in the reasonably foreseeable future.

**Intensity:** Describes the nature of a wildfire in terms of its rate of energy release. It is the amount of heat given off by a wildfire over a period of time. Increasing heat released over shorter lengths of time, indicate high intensity wildfire. Intensity can be measured by flame length.

**Interdisciplinary Team (IDT):** A group of individuals with different specialized training assembled to solve a problem or perform a task. The team is assembled out of recognition that no one discipline is sufficiently broad to adequately solve the problem. Through interaction, participants bring different points of view and a broader range of expertise to bear on the problem.

**Interior Forest:** Interior Forests are considered contiguous areas of relatively dense and large trees that are buffered from temperature, light and humidity differences of sizable forest openings, and from human disturbances along regularly used roads and trails.

**Intermittent Stream:** A stream that flows only at certain times of the year, as when it receives water from springs or from a surface source, such as melting snow. A stream that does not flow continuously, as when water losses from evaporation or seepage exceed the available streamflow.

**Ips (Pine Engraver Beetle):** A genus of bark beetle that feeds beneath the bark of pines, typically killing branches, tops, or entire trees. These beetles often breed in logging slash or attack stressed and injured pines.

**Ladder Fuel:** Fuels that bridge the gap between surface fuels and the tops, or crowns, of a tree. For example, intermediate trees or trees with low hanging branches can provide pathways for a wildfire to move from the ground to the tops of larger trees.
**Legacy Tree:** Also referred to as heritage tree or old growth tree.

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

**Management Indicators (Wildlife)** Plant or animal species or habitat components selected in a planning process that are used to monitor the effects of planned management activities on populations of wildlife and fish, including those that are socially or economically important.

**Management Objectives** Clearly stated objectives describing the intended post-management status of an area. Typically, objectives are disclosed in the NEPA documentation.

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

**Meadow:** An area of perennial, herbaceous vegetation, usually grass or grass-like. A natural opening in a forest, generally at higher elevations, that produces exceptional levels of herbaceous plants, which is usually a consequence of high soil/water content or a perched water table. Generally, a prairie grassland will occupy a convex surface while a meadow will occupy a concave surface.

**Monitoring:** The sample collection and analysis of information regarding Forest Plan management practices to determine how well objectives have been met as well as the effects of those management practices on the land and environment.

**Motor vehicle:** Any vehicle which is self-propelled, other than:

1. A vehicle operated on rails; and
2. Any wheelchair or mobility device, including one that is battery-powered, that is designed solely for use by a mobility-impaired person for locomotion, and that is suitable for use in an indoor pedestrian area.

**Motor vehicle use map (MVUM):** A map reflecting designated roads, trails, and areas on an administrative unit or a Ranger District of the National Forest System.

**Mulching:** The process of reducing larger woody slash into finer material and mixing with soil. Material is generally mulched 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 will 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 will 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 will give the greatest dollar return or the greatest unit output.
National Environmental Policy Act of 1969 (NEPA): An act declaring a national policy to encourage productive harmony between people and their environment; to promote efforts that will prevent or eliminate damage to the environment and the biosphere and simulate the health and welfare of people; to enrich the understanding of the ecological systems and natural resources important to the nation; and to establish a Council on Environmental Quality.

National Forest Management Act (NFMA): A law passed in 1976 amending the Forest and Rangeland Renewable Resources Planning Act that requires the preparation of Regional and Forest Plans and the preparation of regulations to guide that development.

National Forest System (NFS) Land: Federal lands designated by Executive Order or statute as National Forests, National Grasslands or Purchase Units, or other lands under the administration of the Forest Service.

National Forest System road (NFSR): A forest road other than a road which has been authorized by a legally documented right-of-way held by a State, county, or other local public road authority.

National Forest System trail: A forest trail other than a trail which has been authorized by a legally documented right-of-way held by a State, county, or other local public road authority.

National Register of Historic Places (NRHP): A list of heritage resources that have local, state, or national significance. The list is maintained by the Secretary of the Interior.

Natural Fuels: Fuels resulting from natural processes and not directly generated or altered by land-management practices (compare activity fuels).

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. quaking aspen).

Non-motorized Activities: Activities that do not incorporate the use of a motor, engine, or other non-living power source. Non-motorized activities exclude such machines as aircraft, hovercraft, motorboats, automobiles, motor bikes, snowmobiles, bulldozers, chainsaws, rock drills, and generators.

Noxious Weeds: Those plant species designated as weeds by federal or state laws. Noxious weeds generally possess one or more of the following characteristics: aggressive and difficult to manage; poisonous; toxic; parasitic; a carrier or host for serious insects or diseases; and generally non-native.

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.

Obliteration (Transportation): The reclamation and/or restoration of the land occupied by a transportation facility for purposes other than transportation.
**Off-Highway Vehicle (OHV):** Any motorized vehicle designed for or capable of cross-country travel on or immediately over land, water, snow, ice, marsh, swampland, or other natural terrain.

**Patch cutting:** Clearcutting of small areas (less than 5 acres).

**Pile Burn (a type of prescribed fire):** 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), Products Other Than Sawlogs, Products Other Than Sawtimber:** 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) (4.5 feet from ground level) and less than 7.9 inches diameter breast height (dbh), with tops of trees greater than 4 inches to less than 6 inches in diameter.

**Project:** One or more site-specific activities designed to accomplish a specific on-the-ground purpose or result. Projects are tiered to the Forest Plan and will have further site-specific analysis.

**Ranger District:** Administrative subdivisions of the Forest supervised by a District Ranger who reports to the Forest Supervisor.

**Raptor Habitat:** Habitat required by hawks, falcons or owls, especially for nesting.

**Rate of Spread (Fire Management):** Relative activity of a fire in extending its horizontal dimensions, expressed as rate of increase of the perimeter, rate of increase in area, or rate of advance of its head, depending on the intended use of the information, generally in chains or acres per hour for a specified period in the fire's history.

**Reforestation:** Reestablishment of a tree crop on forested land.

**Regeneration:** The renewal of vegetation whether by natural or artificial means. Also, the new growth itself.

**Resource Value-at-risk (Fire Management):** Fire-suppression planning tool providing a relative expression in five classes of fire effects on all resources but not the value of the resources themselves (compare values at risk).

**Resource Values:** The tangible and intangible worth of forest resources.

**Responsible Official:** The Forest Service employee who has the delegated authority to make a specific decision.

**Retention (Vegetation Management):** To keep the existing extent of a vegetative component. Usually refers to a species, such as quaking aspen, birch, or bur oak.
Revegetation: The reestablishment and development of a plant cover. This may take place naturally through the reproductive processes of the existing flora or artificially through the direct action of reforestation or reseeding.

Rights-of-way: Land authorized to be used or occupied for the construction, operation, maintenance, and termination of a project or facility passing over, upon, under, or through such land. The privilege that one person or persons particularly described may have of passing over the land of another in some particular line.

Riparian Ecosystem: The moist transition zone between the aquatic ecosystem and the relatively drier, more upland, terrestrial ecosystem(s). This transition zone can extend both laterally and longitudinally away from aquatic ecosystems, sometimes into headwater swales that have no defined stream channel. The riparian ecosystem is the area whose soil is relatively more moist than the adjacent upland and whose vegetation growth reflects the greater accumulation of available water.

Road: A motor vehicle route over 50 inches wide, unless identified and managed as a trail.

Road construction or reconstruction: Supervising, inspecting, actual building, and incurrence of all costs incidental to the construction or reconstruction of a road.

Road Decommissioning/Obliteration: Activities that result in the stabilization and restoration of unneeded roads to a more natural state.

Road Maintenance: The upkeep of the entire forest transportation facility including surface and shoulders, parking and side areas, structures, and such traffic-control devices as are necessary for its safe and efficient utilization.

Road Maintenance Level: Defines the level of service provided by and maintenance required for a specific road consistent with road management objectives and maintenance criteria. The maintenance levels are:

- **Maintenance Level 1**: Assigned to intermittent service roads during the time they are closed to vehicular traffic. The closure period is 1 year or longer. Basic custodial maintenance is performed.
- **Maintenance Level 2**: Assigned to roads open for use by high-clearance vehicles. Passenger car traffic is not a consideration.
- **Maintenance Level 3**: Assigned to roads open and maintained for travel by a prudent driver in a standard passenger car. User comfort and convenience are not considered priorities.
- **Maintenance Level 4**: Assigned to roads that provide a moderate degree of user comfort and convenience at moderate travel speeds.
- **Maintenance Level 5**: Assigned to roads that provide a high degree of user comfort and convenience. Normally, roads are double-laned and paved or aggregate-surfaced with dust abatement.
Road Reconstruction: [Definition from previous 36 212.1]. Activity that results in improvement or realignment of an existing authorized road as defined below:

   (1) Road improvement: Activity that results in an increase of an existing road's traffic service level, expands its capacity, or changes its original design function.
   (2) Road realignment: Activity that results in a new location of an existing road or portions of an existing road and treatment of the old roadway.

Sanitation: The removal of trees occupied by insect or disease pests to reduce pest populations and limit their spread.

Salvage: Removal of damaged, dead or dying trees resulting from insect and disease epidemics, wildfire, or storms.

Scarify: To abrade, scratch, or modify the surface of the ground to expose mineral soil.

Scenery: The composition of basic terrain, geologic features, water features, vegetative patterns, and landrise effects that typify a land unit and influence the visual appeal the unit may have for visitors.

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

Silvicultural Treatment: A management practice that utilizes a method of tree culture, harvest, or replacement.

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: An area considered in terms of its physical and/or biological environment; for example, a riparian zone, a homogenous stand of vegetation, or a campground.

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 or insect and disease. Slash can consist of branches, tree tops, logs, and broken or uprooted trees.

Soil Compaction: A physical change in soil properties that results in a decrease in porosity and an increase in soil-bulk density and strength.

Soil Erosion: The detachment and movement of soil from the land surface by water or wind.
**Soil Productivity:** The inherent capacity of a soil to support the growth of specified plants, plant communities, or a sequence of plant communities. Soil productivity may be expressed in terms of volume or weight/unit area/year, percent plant cover, or other measures of biomass accumulation.

**Standard:** Mandatory courses of action; any deviation from standards requires amendment of the LRMP.

**Stand:** A community, particularly of trees, possessing sufficient uniformity as regards to vegetation type, age class, risk class, vigor, size class, and stocking class that distinguishes it from adjacent communities and thus forms a management or silvicultural unity. Within a stand, a dominant or primary species and age class is identifiable, but there may be inclusions or clusters of different species or ages.

**Stand-replacing Fire:** A fire that kills all or most living overstory trees in a forest and initiates secondary succession or regrowth.

**State Historic Preservation Officer (SHPO):** A person appointed by a state's governor to administer the State Historic Preservation Program.

**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 during which 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.

**Subdivisions:** Areas of previously undeveloped land divided into individual home sites and/or blocks of lots.

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

**Suitability:** The appropriateness of applying certain resource management practices to a particular area of land, as determined by an analysis of the economic and environmental consequences and the alternative uses foregone. A unit of land may be suitable for a variety of individual or combined management practices.

**Surface Fuels:** Fuel on the surface of the ground, consisting of: needle litter, dead branches, downed logs, and low growing plants.
**System road:** [Not from 36 CFR 212.1]. As used in this document, an abbreviated reference to a National Forest System road.

**Temporary road or trail:** A road or trail necessary for emergency operations or authorized by contract, permit, lease, or other written authorization that is not a forest road or trail and that is not included in a forest transportation atlas.

**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.

**Threatened Species:** Any species likely to become endangered within the foreseeable future throughout all or a significant portion of its range and that has been designated in the Federal Register by the Secretary of Interior as such.

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

**Trail:** A route 50 inches or less in width or a route over 50 inches wide that is identified and managed as a trail.

**Travel management atlas:** An atlas that consists of a forest transportation atlas and a motor vehicle use map or maps.

**Travel Analysis:** [Not from 36 CFR 212.1]. A roads analysis that also includes motorized trails and areas.

**Treated Area:** Area on which management such as thinning or prescribed burning occurs.

**Values at Risk:** Any or all natural resources, improvements, or other values that may be jeopardized if a fire occurs.

**Viewshed:** Total visible area from a single observer position or the total visible area from multiple observer positions. Viewsheds are accumulated seen areas from highways, trails, campgrounds, towns, cities, or other view locations. Examples are corridors, feature, or basin viewsheds.

**Unauthorized road or trail:** A road or trail that is not a forest road or trail or a temporary road or trail and that is not included in a forest transportation atlas.

**Unrecovered burn:** A burn that has insufficient ground cover to reduce erosion rates to pre-burn conditions. Typical time to recovery is 2-4 years, but is highly variable with vegetation type and precipitation. Grass, whose roots are left intact following fire, may recover in one growing season. Lodgepole pine, that often lacks an understory, usually takes longer to recover, because seeds need to be transported in from outside the burned area. Extended draught can lengthen the recovery before vegetation will be established. The typically lower fire severity of prescribed fire may shorten recovery times. Research along the Front Range indicates that ground cover of 60%-80% typically will reduce erosion and sediment to background levels.
**Watershed:** The area of land bounded by a divide that drains water, sediment, and dissolved materials to a common outlet at some point along a stream channel or to a lake, reservoir, or other body of water. Also called drainage basin or catchment.

**6th Level Watersheds:** A watershed coded with a 12-digit code, typically 10,000 to 30,000 acres in size.

**Way:** A term used in the Forest Plan documentation to denote an unauthorized road or trail. This term has been superseded by the term and definition found in the Code of Federal Regulations. Any references to a “way” should be replaced by unauthorized road or trail.

**Wildland Fire Management Strategy:** Overall plan for managing unplanned wildfire ignitions. The strategy gives consideration to the values threatened, potential fire behavior, legal constraints and natural resource management objectives. All wildland fires would be controlled by one of three strategies:

- **Direct Control:** The intent is to immediately and completely extinguish wildfire.
- **Perimeter Control:** A strategy that seeks to confine the activity of a wildfire to a specified zone. Zones are determined by threatened values and the benefits of wildfire effects.
- **Prescription Control:** The fire is considered to be controlled as long as it burns within specified geographic boundaries and predetermined burning conditions. These parameters are determined in advance and detailed in a written prescription. Fires that fall within this prescription are allowed to continue to burn.

**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.
Purpose and Need for Action

The purpose of this project is 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) in the Forsythe Project Area. Since the mid 1990s, the Colorado Front Range has shown an increase in pine tree death due to MPB. Surveys show large increases in beetle related tree death in and around the Forsythe Project Area and in many places they are at or approaching epidemic levels. Beetle kill trees fall to the ground and add dry fuels to the landscape, creating a high wildfire hazard. High rates of tree death also change vegetation and wildlife habitat on a landscape scale. MPB like dense groups of mature pine trees, which is abundant throughout the project area. The most common practice for reducing MPB tree death is to mechanically remove the infested trees and reduce the density of the remaining trees.

The Colorado Front Range has been affected by large, intense forest fires due to the lack of forest openings, continuous forest, and increasing forest density. Since the 1980s, we have seen a dramatic increase in the amount of acreage burned by wildfire. Recent fires, including but not limited to the Bobcat Gulch, Hayman, Overland and Four Mile Fires have burned over 500,000 acres to date. These large fires have had a significant impact on our environment, economy, cultural and forest resources, as well as human life and property.

In December 2003, the Healthy Forests Restoration Act was signed into law. This legislation authorizes fuel reduction treatments on National Forest System (NFS), Bureau of Land Management (BLM) and Tribal lands to reduce the threat of wildfire to those communities determined to be at-risk. This act further defines ‘at-risk communities’ as “… homes and other structures with basic infrastructure and services”. At-risk communities include: Nederland, Boulder, Wondervu, Pinecliffe, Lincoln Hills, Pactolus; the subdivisions of Big Springs, Tungsten, Walker Ranch, and Sugarloaf. In addition to the communities mentioned above, there are approximately 8,853 acres of private land that fit this definition within the project area including the Retreat and Cedar Park subdivisions.

This project responds to part of the purpose for HFRA (Section 2) to:
1) Reduce wildfire risk to communities, municipal water supplies, and other at-risk federal land through a collaborative process of planning, prioritizing, and implementing hazardous fuel reduction projects.
2) Enhance efforts to protect watersheds and address threats to forest and rangeland health, including catastrophic fire, across the landscape.
3) Protect, restore, and enhance forest ecosystem components to improve biological diversity.

The Forsythe Project Area contains a large area of interface between public and private land. Many residents of these areas are aware of the potential for wildfire and the effects it can have on their property and daily lives. Past fires across the Front Range of Colorado have clearly underscored the need for collaboration between property owners and associations and State and County agencies to create areas of defensible space around homes and other improvements on
Vegetation in the area is susceptible to wildfire events, especially crown fire. During the last century, a buildup of forest fuels and changes in the composition of the forest have occurred. The accumulation of dead and down fuels and the number of small diameter trees have increased. The arrangement of these fuels provides a pathway for fire to move from the ground to the crowns of larger trees (see cover photo). Under these conditions, even wildland fire ignitions under average weather conditions have the potential to become fast-moving and destructive crown fires.

This buildup and arrangement of fuels has occurred in part from almost 100 years of active wildfire suppression. Prior to active wildfire suppression, naturally caused fires periodically burned at low and moderate intensities removing some dead fuels and reducing the number of small trees. In the Forsythe Project Area, where human development has occurred, fire size has been kept artificially small because of potential threats from wildfire to this development. As the population along Colorado’s Front Range increases, more homes are being built in forested areas creating a larger and more complex wildland-urban interface. Wildfire suppression will continue to be active because of the increased threats to life and property.

The overcrowding of trees also reduces the health and vigor of individual trees making them more susceptible to disease and insect attack. Past insect epidemics combined with the lack of wildfire has caused increased fuel loadings that may lead to more severe wildfire behavior. This increase in small diameter conifer trees has also caused encroachment into quaking aspen stands and meadows, reducing the amount of biological diversity. Maintaining healthy stands of quaking aspen and meadow areas provides effective forage and habitat for the large elk herds that gather in the vicinity of Winiger Ridge. In addition to providing biological diversity, quaking aspen stands are also more resistant to wildfire than other local forest types.

In order to address these conditions and meet purposes of the HFRA, the following needs were identified as goals for the project area:

- 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.

- There is a need to increase the amount and vigor of quaking aspen stands and meadows across the project area. Quaking aspen stands are generally areas of greater moisture that can reduce the intensity of wildfires. 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. These areas also provide habitat for a variety of wildlife and add to the biodiversity of the project area.
Proposed Action

In order to address the need to apply appropriate vegetative treatments to maintain or improve watershed and forest health, and reduce hazardous fuels and modify wildfire behavior in the project area, the Boulder Ranger District proposes to implement hazardous fuel reduction treatments on National Forest System lands. The proposed project area boundary encompasses approximately 18,120 acres. Of that total, approximately 9,267 acres are NFS lands. The remaining acres are private, state, county, or other ownerships, which are intermixed throughout the project area. These parcels range in size from one to two acre residential lots in subdivided areas to over 200 acres.

Property owners in cooperation with the Colorado State Forest Service, Boulder County, and Gilpin County are beginning to, or continuing to create areas of defensible space around homes and other improvements on private lands. Public comment and collaboration, as well as input from U.S. Forest Service resource specialists, is used to develop and refine the Forsythe proposal. Prior to development of this proposed action, maps and ground surveys of the project area were used to identify conditions that may limit or preclude fuel reduction treatments. Examples of these limiting factors are soils with severe erosion hazards, threatened or endangered species habitat, or riparian areas. The proposed treatment unit boundaries were either located around these areas, or, specific restrictions on the types of treatments (generically called ‘Project Design’) were established to minimize or avoid impacts. After consideration of all of these factors, approximately 5,381 acres have been proposed for treatment.

To implement the goals and objectives of this project, the Forest Service proposes to use three types of treatments on National Forest land within the Forsythe Project Area. The first type of treatment (proposed for approximately 4,300 acres) would include selective cutting of conifers while leaving healthier and more fire resistant trees and conifer stands less susceptible to MPB infestations. Secondly, prescribed broadcast burning would be used on approximately 968 acres to accomplish the same goal of reducing the amount of flammable fuels. Lastly, stands of quaking aspen and meadow areas that are slowly being encroached on by conifer trees would be restored by removing conifers from these areas. To maintain the size and vigor of an estimated 296 acres of quaking aspen stands and 209 acres of meadows, individual conifer trees would be cut by various methods.

Public Involvement

The HFRA encourages meaningful public participation early in the planning stages of hazardous fuel reduction projects. Working in collaboration with adjacent communities, interested individuals, and State and local governments is essential to setting priorities and designing effective treatment areas. As a means of informing property owners and gathering specific local input, a public meeting was held in Nederland, Colorado on September 29, 2011. A letter announcing the meeting was mailed to landowners adjacent and within to the project area and to other stakeholders such as federal, state, and local governments; Native American Tribes; special interest groups; and other interested individuals and organizations. A press release was sent to all local newspapers including the Nederland Mountain-Ear and the Boulder Daily Camera. The
release was also posted on the town of Nederland’s website. Approximately 40 people attended and were informed about the proposed action and given an opportunity to ask questions.

In addition to the public meeting, a specific mailing list focusing on adjacent subdivisions and individual property owners was developed. On September 14th, 2011, individual letters requesting comments on the proposal were sent to approximately 2000 recipients (a copy of the scoping letter and the mailing list are available in the project record). This letter was also posted on the Forest’s website.

The proposal was listed in the Forest’s Schedule of Proposed Actions beginning in September of 2011. This document is available on the National Forest website and is monitored by individuals and organizations interested in management of National Forest System lands. From these combined outreach efforts, 135 comments were received. Using these comments from the public and other agencies, the Forest Service developed issues to address and incorporated public input as part of project design.

**Issues**

The Forest Service uses an interdisciplinary process to separate issues brought up during scoping into groups of relevant and non-relevant issues. Relevant or key issues are those the public provided most input on. Non-relevant issues are identified as those that are: 1.) outside the scope of the proposed action; 2.) already decided by law, regulation, Forest Plan, or other higher level decision; 3.) irrelevant to the decision to be made; or, 4.) conjectural and not supported by scientific or factual evidence. The Council on Environmental Quality (CEQ) NEPA regulations require this delineation in Sec. 1501.7, “…identify and eliminate from detailed study the issues which are not significant or which have been covered by prior environmental review (Sec. 1506.3)…” However, at the discretion of the Responsible Official, some non-significant issues may be considered as part of project design for the proposed action.

Comments received during the scoping process were reviewed and grouped together into issues. Overall, there was a favorable response to the proposed action and the need for fuels treatments and addressing prevalent MPB conditions. The following is a summary of the comments received during scoping. For information beyond these issues presented, refer to resource information and Project Design detailed in Chapter 2. Similar issues are grouped below followed by a determination of their relevance in regards to the project.

1.) **Carrying Work Through and Funding**

Many comments were received on the Forest Service’s ability to see the work through with the funding we have, most notably burning of piles and closing of temporary roads and other improvements including skid trails, landings, equipment staging areas, and existing road improvements. Budgets for the Forest Service to accomplish its mission are approved by Congress and the President on an annual basis. The Washington Office of the Forest Service distributes funding through Regional Offices, Forest Headquarters, and finally to individual Ranger Districts to perform work on the ground. There is no guarantee on the amount of funding to be received year to year. However, certain programs, such as hazardous fuel reduction, have seen relatively constant levels of funding over the last ten years, particularly on Colorado’s Front
Range. Furthermore, if the work is to be completed by a private contractor, funding for the contract must be in place before the contract can be awarded. This reduces the chances of a treatment area being partially finished.

Final completion of hazardous fuel reduction treatments often involves disposal of slash piles and rehabilitation of disturbed areas, each is described below:

- Piles are constructed to minimize slash through treatment activities. After treatment, piles remain a fire hazard until they are disposed of. Disposal methods include removal, chipping and scattering, or burning. Removal of piles involves using a chipper or grinder and hauling the material off site, or loading piled material onto a dump truck and hauling off site. Chipping and scattering occurs in areas where piles can be chipped and chips can be scattered at 3” or less chip depth. Pile burning work is only completed by Forest Service employees or under Forest Service supervision. The location of piles and weather conditions can be barriers to timely completion of this activity. Lower elevations are less likely to have periods of continuous snow cover which reduces the opportunities to safely burn piles.

- Rehabilitation includes evaluating the effects of ground disturbing activities and prescribing treatments to improve the recovery of these areas. These activities include skid trail and landing rehabilitation, equipment staging area rehabilitation, temporary road obliteration, rehabilitation of existing road improvements, burn pile rehabilitation, and noxious weed treatment. Most rehabilitation can be completed with contracts within a year for fuels treatment activities. The Forest Service completes these activities to ensure site recovery and to keep unregulated motorized and non-motorized recreation at a minimum. Weed spraying is completed by the Forest Service or by a separate contract. The Forest Service recognizes the need to complete these activities as part of a comprehensive design of fuels reduction treatments and is committed to leaving areas finished and closed.

2.) Previously Treated Areas

During the scoping process, many comments were received about proposing treatments within areas treated in the Winiger Project over the last 10 years. The Winiger project treated approximately 1,500 acres with manual and mechanical treatments and 50 acres with prescribed broadcast burning. The Forest Service proposes to treat some of the same areas treated in the Winiger Ridge Project due to current conditions. For example, some of the same areas may be treated again due to MPB infestation or increased hazardous fuels conditions. These conditions include accumulation of heavy slash or new regeneration of pine or Douglas-fir that would require treatment to decrease the potential intensity of wildfire. Areas which are not infested with MPB or present little to no fire hazard may be left untreated.

3.) MPB Treatments

There were questions posed to the Forest Service if treatments proposed in the Forsythe Project were an attempt to control MPB populations. The Forest Service recognizes that MPB is currently at epidemic levels in portions of the project area and realizes not every acre will be treated. However, where treatments are proposed in individual stands, the hazard from the spread of MPB can be lowered in ponderosa pine stands. Research has noted that if stands are
treated to 74 ft$^2$ per acre of basal area or lower and the infested trees are removed through sanitation. MPB hazard can be reduced (Negron et al, 2003). In lodgepole pine stands, MPB would be addressed with sanitation and removal of infested trees to address existing infestations as thinning causes a high potential for blowdown. Sanitation is effective in that it removes beetles from the stand, however effectiveness of treatment in regards to MPB, is only as effective as the scope of which it is applied to the landscape.

During the scoping process, individuals asked if any chemical applications were proposed as part of the Forsythe Project due to the concern over the use of chemicals such as carbaryl. The Forsythe Project does not propose application of any chemicals for MPB control or mitigation. However, the Forest Service evaluates high priority areas such as campgrounds, picnic areas, and ski areas for chemical application on an annual basis through separate decisions, and has for the last 4 or 5 years completed application of carbaryl to greatly reduce the likelihood of identified pine from becoming infested.

Other comments received addressed the thought that fuel reduction treatments are at odds with MPB treatments. The Forest Service realizes the need to address the MPB epidemic within proposed fuels treatment units. Through time, trees killed by MPB die and fall to the ground creating a very high fire hazard. If infested or large numbers of dead trees are not removed, the Forest Service would not be meeting the purpose and need of the project to reduce hazardous fuels.

Concern was expressed in the timing of treatment and the effective removal of MPB from the Forest. MPB lives on a one-year life cycle. Beetles are found within infested trees between September and May. Roughly between May and September, beetles fly from infested trees to infest other pine trees. The best strategy for removing MPB trees is removing them between September and May to reduce the spread to other uninfested pine. When cutting occurs during the summer, more care is required to insure infested trees are removed from the forest.

Landowners and local governments expressed a concern that after treatment cut MPB infested trees could be moved to other areas where they could infest new trees and cause further spread of the MPB epidemic. Research has noted that through transport, MPB will stay in logs and other material until it has reached its destination at a mill or stockyard (Schaupp et al, 1993). Generally, forest products cut as part of the proposed action would be transported to other locations outside the project area for processing. People who live in forest areas that are interested in removing MPB infested trees from their property should consult their local State Forester.

For further information on the proposed action and MPB, refer to the Silviculture section of this EA (Chapter 3, page 90).

4.) Effects on Wildlife

Comments were noted about the effects to wildlife migration from patch-cuts and mechanical treatments. Please refer to the wildlife section of this report (Chapter 3, Page 104) for disclosure of such effects, as each species identified has its own effects from fuels treatment activities.
Concerns were addressed from adjacent landowners, cooperating agencies, and the general public about the effects of fuels treatment on elk including hiding cover, thermal cover, and effects of disturbance due to fuels treatment activities. Treatment units LP 6 (area north of Giggy Lake) and LP 12 (north slope of Winiger Ridge) were identified as important hiding cover for elk. The Project Area also encompasses elk summer range, winter range, severe winter range, and winter concentration. Impacts to elk would occur if they are present during fuels treatment activities and elk have been known to move away from these areas for a long period of time after treatment. As a measure to prevent the severe impact of elk leaving the area, the north side of LP 6 will be retained as elk thermal and hiding cover to insure continued elk use. LP 12 may be entirely excluded from treatment based on surveys that elk frequent this area.

Many members of the public requested the Forest Service to identify timing restrictions for fuels treatment activities based on wildlife and their habitats. These are described in the Project Design section of this document and the Forest Plan (1997), and include:

- There should be no operations April 1 through August 30 for 1,300 feet surrounding flammulated owl nest sites. (Project design)
- All raptor nest buffers will have no activity from March 1 through September 15 (depending on species) or until determined unoccupied by the wildlife biologist. This includes prep work. Access through buffers should be assessed by the Wildlife Biologist. (Project Design)
- Outside of the raptor breeding season from September 16 through February 28, limited thinning may be allowed within the buffer if determined necessary to help reduce the risk of losing the nest site to wildfire. (Project Design)
- Buffer raptor nest sites during fledgling from March 1 through July 31. (Forest Plan)
- Avoid bighorn sheep habitat from May 1 through June 15. (Forest Plan)
- Avoid elk calving areas from May 15 through June 15. (Forest Plan)
- Avoid elk and deer winter range from December 1 through March 30. (Forest Plan)

Comments were noted about the effects to raptor activity from fuels treatment activities. Please refer to the wildlife section of this report (Chapter 3, Page 104) for disclosure of such effects, as each species identified has its own effects from fuels treatment activities.

5.) Cutting of Large Diameter Ponderosa Pine

Many comments were received asking the Forest Service to leave large diameter trees, especially ponderosa pine. The Forest Service recognizes the need to leave large diameter ponderosa pine on the landscape and their ecological importance. The proposed action specifically does not address tree size. Reducing fuels requires reducing the potential for both crown fire initiation and crown fire spread through surface and crown fuel reduction. In most cases, large trees are left in these types of fuels treatments except when tree crowns are too dense across the treatment area, or in areas where most trees are large. With the current MPB epidemic, there may be a need to remove large trees; most notably large pine trees that become infested by MPB would be removed to reduce the MPB hazard and future fuel hazard within treatment areas. For further
discussion on the removal of large diameter ponderosa pine, refer to the Silviculture section of the EA (Chapter 3, Page 90).

6.) **Windthrow/Blowdown**

Due to the high winds in the winter and spring within the project area, areas proposed for treatment, especially lodgepole pine stands, pose a high potential for windfall or blowdown of remaining trees. The treatments proposed would consider the effects of windfall and would attempt to minimize damage to low levels. Please refer to the silviculture section of the EA (Chapter 3, Page 90) for further discussion on windfall and blowdown.

7.) **Prescribed Broadcast Burning**

During scoping, comments were received about the effects to human health from smoke and the need for notification of interested and affected individuals before burning activity occurs. Prescribed broadcast burning occurs under the guidance of a burn plan and would be preformed by qualified individuals. Approval of a burn plan by the District Ranger is required before the burn can be implemented. Before burning would occur, holding features such as roads or trails must be designated or new features such as constructed fireline must be established in order to prevent the chance of fire escaping the burn area. Burns are supervised by a qualified Burn Boss, who has qualified staff including the Holding Boss and Ignitions Boss. Burns can only occur under strict weather parameters where the chance of escape is minimal, smoke is dispersed away from local communities, and where fuels reduction objectives can be obtained. If these items cannot be met during burning operations, the burning operations are shut down until they can be met at a later date. For further detail about Prescribed Broadcast Burning see the Fire/Fuels section of this EA (Chapter 3, Page 73).

8.) **Effects on Soils**

With 968 acres of prescribed broadcast burning proposed, individuals expressed concern on the effects this activity could pose to the soil resource. To address this issue, burns would be conducted at low severities. Also, many project design items would be followed in burning operations, which include:

- Conduct prescribed fire and pile burns to minimize the residence time on the soil while meeting the burn objectives. This is usually done when the soil and duff are moist (not wet).
- Limit unrecovered burned area (see glossary for definition) to no more than one third of the total acres per year.
  - Design and implement prescribed fire for low soil burn severity effects, rapid recovery of effective ground cover and low post treatment soil erosion and sedimentation.
- No active ignition within 100 feet of water.
- Rehabilitate constructed fire lines by installing water bars, raking topsoil back over the line, covering with slash or other mulch materials; and seeding, if recommended by a Forest Service botanist.
Another noted concern was the effects of mechanized equipment operations on the soil, particularly soil compaction and erosion. Through project design in this document the Forest Service has set forth guidelines to ensure soils are not detrimentally affected through management activities where mechanized equipment is used (Chapter 2, Page 33). Generally, mechanized equipment would not operate during wet periods when the soil would be wet; these conditions which could create the highest potential for detrimental soil effects.

9.) **Effects on Roads and Trails**

A concern was expressed about roads and trails and how the Forsythe Project could affect recreational activities. Further it was noted that density reduction of pine stands through mechanical treatments have been known to increase the amount of user-created roads and trails. Cutting specifications require that any cut material be removed utilizing legally designated roads and trails; furthermore, any legally designated roads, trails, as well as any other recreation developments would be protected. During cutting operations, mechanical equipment and chainsaw noise will be evident; however, this effect would be considered temporary. After treatments would occur, any temporary roads or other improvements created by fuels treatment activities would be obliterated. The result of the obliteration would be an effective closure to prevent user created roads and trails. For further information on recreation and roads, refer to those sections in Chapter 3 of this EA (Pages 143 for roads and 147 for recreation).

10.) **Noxious Weeds**

Noxious weed spread as a result of ground disturbance from fuels reduction activities on the Boulder District was noted in some comments received. Land actions that disturb the ground have the potential to contribute to the spread of noxious weeds and other non-native plants. The project will incorporate integrated weed management measures under the Forest’s Noxious Weed Management Plan. The analysis conducted in the Environmental Assessment for the Noxious Weed Management Plan determined noxious weed control actions are consistent with laws and regulations applicable to the management of National Forest System lands and resources. (Chapter 3, page 126).

11.) **Scenery**

Many who commented on the scoping letter expressed a concern about the use of paint and flagging on trees and the effects these have on the visual resource. Flagging and tree marking paint are used to identify and designate cutting units. Flagging is generally not removed as it is made from biodegradable materials. Paint is used to clearly identify boundaries for cutting activities, however the Forest Service would address visual impacts through specific project design (Chapter 2, page 40) followed through boundary and tree marking performed in a way that it cannot be easily seen from developed private property, main roads, and main trails and done in a way that follows Forest Service Standards.

The north slope of Winiger Ridge is very visible to people in the forest with a view looking south from the Magnolia Road area. There was a concern noted that patch cuts and/or sanitation with removals would severely degrade this view. The Forest Service considers visuals an important
aspect of the layout of the cutting areas and would address this concern by incorporating project
design from a professional Landscape Architect. (Chapter 2, Page 40).

12.) Map Detail

Numerous comments were received on the level of detail of the map included in the scoping
letter. The map can be found on page 31 of this document.

For a more detailed map, go to: http://fsweb.arnfpng.r2.fs.fed.us/
Then on the left click on "Land and Resources Management"
Next on the left click on "Projects"
Within the next page the Forsythe project.

13.) Climate Change

Comments were received on the project’s effects on Global Climate Change. It is not currently
feasible to quantify the indirect effects of individual or multiple projects on global climate
change; therefore determining significant effects of those projects or project alternatives on
global climate change cannot be made at any scale.

14.) Addition to the Proposed Action

During scoping, landowners and community leaders from the town of Nederland proposed
additional treatment area to the original proposed action from the Forest Service. The identified
area has been noted as a key access and egress point to many residents who reside in the Big
Springs Development. This area was also recommended for treatment in the Nederland
Community Wildfire Protection Plan (CWPP). This proposed area is southeast of Nederland and
is approximately 56 acres in size. The proposed treatment for this area would be a Lodgepole
Pine Treatment and is identified on the Proposed Action map as “LP 25”.
Chapter 2 - Description of Alternatives

Alternatives Considered but not Analyzed in Detail

An alternative to treat steep slopes with advanced logging systems including cable yarders and helicopters was considered by the Forest Service. Due to increased fire behavior on steep slopes, treatments would need to be very aggressive to lower the fire hazard. During the initial analysis, it was determined these treatments are very costly, they require an extensive road system, they can pose high risk to safety of workers/contractors, and can leave high amounts of slash on the ground. Although reducing fuels on steep slopes is important, the costs outweigh the benefits of treatments.

Alternatives Analyzed in Detail

Alternative A – No Action

Under the No Action Alternative, current management actions such as road and trail maintenance would continue within the project area. No hazardous fuel reduction treatments to complement efforts on private lands would be implemented. No action would be accomplished to meet the identified purpose and need of the project. Because the project area contains a high percentage of private land, immediate fire suppression activities would continue and fuel hazard condition would likely continue to increase. The desired conditions for the Forsythe Project Area intended by the Healthy Forest Restoration Act and described in the Forest Plan, would not be pursued.

The No Action Alternative serves as a baseline for comparing the effects of the action alternative on the environment. Analysis of this alternative complies with regulations listed at 40 CFR 1502.14(d) requiring analysis of a no action alternative to be included in the Environmental Assessment.

Alternative B – Proposed Action

The Forest Service proposes to treat hazardous fuels and address increasing populations of mountain pine beetle (MPB) in the Forsythe Project Area. The project area lies west of Gross Reservoir and is approximately 6 miles west of Boulder, CO (see vicinity map). The project area is about 18,120 acres in size and consists of 9,267 acres of National Forest System lands. Inside the perimeter there are 8,853 acres of non-National Forest System lands including private, state, county and other ownership.

The Forsythe Project Area contains numerous full time residences and summer cabins. As a means of reducing the threat from wildfire, many of these property owners have completed, or are in the process of completing, defensible space around their structures. To increase the effectiveness of these fuel reduction efforts and reduce the potential for destructive wildfires affecting private lands, the U.S. Forest Service proposes to treat up to an estimated 5,381 acres of National Forest System lands located within the Forsythe Project Area.
Treatments would be designed to reduce crown fire hazard by reducing the overall density of pine trees, increase fire resilience, treat MPB infested stands, and create a diversity of forest structures across the landscape. Treatment areas with an average tree diameter of greater than 5 inches dbh would be treated in mechanical operations utilizing heavy equipment such as feller-bunchers and skidders. Treatments would be completed utilizing multiple contracts including stewardship and service contracts.

Proposed treatment units were placed adjacent to private land and in areas across the landscape, in order to reduce the potential for intense wildfire behavior. Existing public access routes would be used by the U.S. Forest Service and its contractors where possible. In some cases, a need for additional access across private land may be needed and would need to be negotiated on a case-by-case basis with respective land owners.

Proposed treatments would be based on forest cover type and the presence of MPB infestation, specific site prescriptions will be developed upon completion of this Environmental Assessment and subsequent Decision Notice. *(for further specificity on proposed treatments, refer to the Silviculture section in chapter 3, page 90)*:

Acreages and locations displayed on the proposed action map and listed below are approximate and may vary during implementation based on site specific conditions.

**Lodgepole Pine Treatments – TLP – Proposed on 2,368 acres**

- **Individual patch cuts** - Removal of all trees up to 5 acres by mechanical or manual means on stands or units less than 25 acres.
- **Group selections** – Patch-cuts (up to 5 acres) by mechanical or manual means on stands or units greater than 25 acres (affecting up to 20% of stand or unit acreage).
- **Manual and Mechanical Thinning** – Stand density reduction. This treatment will be utilized much less than patch cuts and group selections due to the high potential for blowdown post treatment. Some areas would be thinned to promote ponderosa pine and Douglas-fir.
- **Sanitation with removal cuts***- Removal of MPB infested pine trees with removal of green pine trees within sanitation areas, where necessary to reduce blow-down potential.
- **Salvage***- Removal of dead pine trees killed by MPB

*Sanitation with removal cuts and salvage treatments would only occur where beetle infestation is present. With heavy MPB infestation, these treatments may appear as a clearcut.

**Ponderosa Pine Treatments – TPP: - Proposed on 1,540 acres**

- **Mechanical and Manual Thinning** – Stand density reduction.
- **Sanitation*** - Removal of MPB infested pine trees.
- **Salvage*** - Removal of dead trees killed by MPB.

*Sanitation and salvage treatments would only occur where beetle infestation is present. With heavy MPB infestation, these treatments may appear as a clearcut.
Aspen Restoration – TAA: - Proposed on 209 acres
  ➢ Removal of conifers from aspen stands to enhance natural fuel breaks, which would also enhance habitat diversity.

Meadow Enhancement – GRA – 209 acres
  ➢ Removal of conifers from meadows to enhance natural fuel breaks, which will also enhance habitat diversity.
  ➢ This treatment would be completed by manual means only to protect grassland vegetation and soils.

Prescribed broadcast burning – 968 acres
  ➢ Prescribed broadcast burning to reduce fire behavior potential, reduce existing fuel loading and fuel loadings from manual and mechanical treatments, and to restore fire back to the landscape.
  ➢ Burning operations would be limited to air quality and weather conditions allowing for safe execution of ignition operations with qualified fire personnel from multiple jurisdictions.
  ➢ Total area to be burned would be broken up into multiple time periods and/or sections to address recovery.
  *For additional information on prescribed broadcast burning, please refer to page 74 of this document

Road Actions
  ➢ Use of existing roads and improvements to existing roads including: surface grading; removal of rolling dips; roadside brushing/tree cutting; widening; addition of passing lanes; reconstruction; installation of culverts or other improvements to stream crossings; relocation to achieve more favorable grades (short segments not significant length); drainage improvements; and turnarounds.
  ➢ Creation of temporary roads following project design to access treatment units and allow for mechanical treatment activities (approximately 10 miles).
  ➢ Obliteration of all created temporary roads after treatment within one year after treatment activities.
  *For additional information on Road Actions, please refer to page 144 of this document.

Table 1 - Treatment Summary Table

<table>
<thead>
<tr>
<th>Proposed Treatment</th>
<th>Prescription</th>
<th>Acres</th>
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<tr>
<td>Lodgepole Pine Treatments</td>
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<tr>
<td>Ponderosa Pine Treatments</td>
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<td>Meadow Restoration</td>
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<tr>
<td>Prescribed Broadcast Burning</td>
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<tr>
<td>TOTAL*</td>
<td>------</td>
<td>5,381</td>
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</tbody>
</table>

*For additional information on Road Actions, please refer to page 144 of this document.

*Treatment areas may overlap where TPP, TLP, TAA, or GRA overlap prescribed broadcast burning.

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Forsythe Fuels Reduction Project EA  Page 28
Table 2 - Vegetation Treatment Tables – See Proposed Action Map for Units

<table>
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<tr>
<td>PP3</td>
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<tr>
<td>PP22</td>
<td>TPP</td>
<td>31</td>
</tr>
</tbody>
</table>

*Addition to Proposed Action from scoping, see page 27 for further information.
Project Design

In response to public comments and collaboration on the proposal, and from analysis by the Forest Service, project design features were developed to minimize the potential impacts Alternative B may cause. Experience has shown from other projects that these project design features can be effective in reduction potential adverse impacts. If Alternative B is selected, the following measures would be included in project design and implementation.

Soil, Hydrology, Fisheries

For all treatment units:
- During winter operations, maintain roads as needed to keep the road surface drained during thaws and break-ups. Perform snow removal in such a manner that protects the road and other adjacent resources. Do not use riparian areas, wetlands or streams for snow storage or disposal. Remove snow berms where they result in accumulation or concentration of snowmelt runoff on the road or erodible fill slopes. Install snow berms where such placement will preclude concentration of snowmelt runoff and will serve to rapidly dissipate melt water.
- Avoid soil-disturbing actions, including travel during periods of heavy rain or wet soils.
- Locate vehicle service and fuel areas, chemical storage and use areas, and waste dumps and areas on gentle upland sites, a minimum of 100 feet from water.
- Fully contain all chemical spills.

Operation of Heavy Equipment for Vegetation Management
- De-compact all compacted landings, temporary roads, and any compacted portions of skid-trails to minimize the accumulation of ground disturbance within the watershed and reduce project related impacts to watershed hydrologic function. This may be waived site specifically if onsite inspection by a Soil Scientist determines de-compaction is not required. Follow de-compaction treatment with erosion control measures such as installing water-bars, covering the area with slash, or re-vegetation as needed.
- The Forest Service shall designate skid trails and landings prior to treatment and re-use existing skid-trails as much as practicable to minimize new disturbance.
- Limit operation of heavy equipment to slopes of less than 30%. Slopes up to 40% may be considered on a site specific basis and would require evaluation by a Soils Scientist.
A no equipment buffer of 100 feet, or to the edge of riparian vegetation, whichever is greater, would be established around perennial and intermittent streams.

- Wetlands, fens, and wet meadows may occur within or adjacent to treatment units. These features may not be mapped and may only be discovered during unit layout. A no treatment buffer of 100 feet or to the edge of riparian vegetation, whichever is greater, shall be established around the wetland, fen or wet meadow.

- For ephemeral streams, equipment shall be excluded from the stream channel, except to cross at points designated by Forest Service Contract or Sale Administrator(s). Retain effective ground cover within a unit according to the appropriate slope gradient ranges as follows:

<table>
<thead>
<tr>
<th>Slope Gradient Range</th>
<th>% ground cover to retain</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-15%</td>
<td>30</td>
</tr>
<tr>
<td>15-25%</td>
<td>30</td>
</tr>
<tr>
<td>25-30%</td>
<td>40</td>
</tr>
<tr>
<td>30-40%</td>
<td>40 - Limited ground treatment</td>
</tr>
<tr>
<td>40-75%</td>
<td>No mechanical treatment</td>
</tr>
<tr>
<td>&gt;75%</td>
<td>No mechanical treatment</td>
</tr>
</tbody>
</table>

- Operate heavy equipment only when soil moisture in the upper 6 inches is below the plastic limit (a ball can be formed in the fist that holds together upon gentle tossing or shaking) OR protected by at least one foot of packed snow or 2 inches of frozen soil. This may mean temporary restrictions on equipment operation in periods of heavy rains or when soils are wet.

- If machine piling of slash is done off landings, conduct piling to leave topsoil in place and to avoid displacement of topsoil. Machinery that lifts and places material into burn piles is recommended over machinery that pushes or drags material into burn piles.

**Manual Treatment**

- Tree cutting of conifers can occur to the edge of the stream bank for perennial, intermittent and ephemeral streams. No riparian vegetation would be cut. Limit cutting of conifers within streambanks to retain a minimum of 50% live conifers.

- Wetlands, fens, and wet meadows may occur within or adjacent to treatment units. These features may not be mapped and may only be discovered during unit layout. No tree cutting would occur within wetlands, fens or wet meadows.

- Burn piles would be located at least 50 feet from perennial streams, wetlands, fens, and wet meadows. Ditches and canals are considered perennial streams if they carry water outside of runoff season or storm events and/or if they support riparian vegetation.

- For intermittent and ephemeral streams, burn piles would be located 50 feet from the stream or outside the inner gorge, whichever is less.

- Lopped and scattered slash would be removed from the stream channel of perennial, intermittent and ephemeral streams.
• Retain effective ground cover of fine fuels to prevent accelerated on-site soil loss and sediment delivery to streams according to the appropriate slope gradient ranges in a unit as follows:

<table>
<thead>
<tr>
<th>Slope Gradient Range</th>
<th>% ground cover to retain</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-15%</td>
<td>30</td>
</tr>
<tr>
<td>15-25%</td>
<td>30</td>
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<td>25-30%</td>
<td>40</td>
</tr>
<tr>
<td>30-75%</td>
<td>50</td>
</tr>
<tr>
<td>&gt;75%</td>
<td>70</td>
</tr>
</tbody>
</table>

Woody Material Disposal and Retention (Large Downed Wood and Fine Slash for Nutrient Cycling and Erosion Control)

• On soils with a severe limitation rating for total tree harvest (topsoil thinner than 1 inch, topsoil organic matter less than 2%, or effective rooting depth less than 15 centimeters or 6 inches), retain at least 5 tons/acre of fine logging slash (less than 3” in diameter) in patch cuts to provide material for nutrient cycling. Slash should be scattered and slash height should not exceed 18 inches.

• In chipped areas, chip depth would average less than 3 inches. Chip depth of up to 5 inches may occur over small areas (not to exceed 5% of the treatment unit). Chips would be distributed in a mosaic pattern over no more than 40% of the activity area.

• In masticated areas, average chunk depth would be 6 inches. Maximum chunk depth would not exceed 12 inches. Chunks would be distributed in patchy or mosaic patterns to avoid dense accumulations and cover no more than 40% of the cutting area across the cutting area.

• Limit the spatial footprint of burn piles to less than 5% of any activity area.

Temporary Road, Landing and Skid-Trail Construction and Obliteration/Restoration

• Construct roads on ridge tops, stable upper slopes, or wide valley terraces where practicable. Stabilize soils onsite. End-haul soil if full-bench construction is used.

• Construct temporary roads where practicable, with out-slope and rolling grades instead of ditches and culverts.

• Stabilize and maintain roads and other disturbed sites during and after construction to control erosion. Strategically place erosion control features in locations to limit impacts to aquatic habitats.

• Obliterate/Restore temporary roads through de-compaction, re-contouring, erosion control and re-vegetation.

Prescribed Broadcast Burning

• Conduct prescribed fire and pile burns to minimize the residence time on the soil while meeting the burn objectives. This is usually done when the soil and duff are moist (not wet).

• Limit unrecovered burned area (see glossary for definition) to no more than one third of the total acres per year.
  o Design and implement prescribed fire for low soil burn severity effects, rapid recovery of effective ground cover and low post treatment soil erosion and sedimentation.
- No active ignition within 100 feet of water.
- Rehabilitate constructed fire lines by installing water bars, raking topsoil back over the line, covering with slash or other mulch materials; and seeding, if recommended by a Forest Service botanist.

**Air**

- Utilize dust abatement to address excessive dust.
- Burn pile size and construction, and all burning operations will comply with State Air Quality standards.

**Lands, Special Uses, and Minerals**

- To avoid damage to the Boulder Gravity Line, driving across the line shall be avoided.
- Consult with Denver Water Board on any project activities occurring within the Federal Energy Regulatory Commission (FERC) boundary for the Gross Reservoir Hydroelectric Project to avoid unnecessary disturbance.
- Roads which have been authorized for private uses shall remain available to those uses to the greatest extent possible. Any deterioration of the road should be repaired to a similar or better condition than before project activities occurred.
- There are several utility (electric, natural gas and communication) lines within the project area. The Contractor and/or the Forest Service shall identify location of these utilities and prevent damage to them.

**Transportation**

- All temporary road construction and road widening for implementation will be obliterated through reclamation of the disturbed areas. This work shall include stabilizing the drainages, partial or full re-contouring and scarification of the road prism, full removal of any stream crossings, restoration of stream channels, placement of erosion and sediment controls, re-vegetation (as determined by a Forest Service Botanist), and effective closures. This work shall be done within one year after use ends as part of the stewardship contract.
- Any non-system roads which are used for access to fuels treatment units may be obliterated.
- Temporary road construction shall be kept to the minimum construction possible to accommodate intended use.
  - Roads shall not follow fall line of the land but shall traverse contours to achieve slopes of 10 percent or less, short reaches may be up to 14 percent in slope.
  - Road alignment shall be selected to minimize cuts and fills to 5-foot maximum.
  - Road widths shall be the minimum required for the equipment and shall not exceed 15-feet.
  - Roads shall be outsloped where possible and rolling dips and drainage features shall be constructed as necessary to control sediment and erosion. Best
Management Practices shall be employed at the termination of drainage features to protect vegetation from sedimentation.

- Construction of temporary roads and road improvements shall to the extent possible minimize ground disturbance, avoid crossings of drainages, provide buffers to drainages and sensitive areas, avoid steep slopes, avoid wet areas, avoid unstable slopes, and shall minimize erosion potential and sedimentation of water ways.
- Planning, construction and maintenance of temporary roads shall include sediment and erosion controls as necessary to prevent resource damage, such controls are to be maintained and supplemented as necessary through the life of the project.
- Existing road conditions shall be assessed prior to implementation for all roads to be used for the project including County and private roads used to access National Forest lands. Roads shall be maintained in their existing condition throughout the project, if any widening or other improvements are required for the project these improvements shall be assessed upon completion to determine if they are acceptable or need to be removed.
- When the work is complete the existing roads shall be inventoried to insure drainage is operational and road surface is intact.
- Unless the condition of an existing or improved road is suitable for truck and trailer traffic, mechanized equipment shall be ‘walked’ (travel under its own power as opposed to transported on a trailer) into any units where mechanical treatments is planned.
- Coordinate all work and traffic that impacts County roads, including hauling, with the County ahead of the work commencing. Obtain County permits as necessary.
- Coordinate with road owners about who will be impacted by the work such as landowners accessing their property, obtain access as necessary and contact information for any temporary closures or other coordination efforts.
- On all existing roads with any level of traffic, use warning signs and traffic control:
  - Uphold in accordance with the “Manual of Uniform Traffic Control Devices.”
  - Maintained for through traffic during felling, slash treatment, and/or removal operations.
  - Leave in operational condition that would adequately accommodate traffic at the end of each work day.
  - On all roads except temporary roads, all felled trees shall be decked or removed and slash piled or removed from the bladed, mowed, or brushed road corridor each day.
  - On temporary roads, have barricades erected and/or proper signs placed at any traffic hazards in or adjacent to the road at the end of each workday.

**Fire and Fuels**

- Slash disposal methods in order of preference:
  - Remove offsite
  - Chip or masticate on site
  - Pile and burn. Creating piles is the last preferred slash disposal method due to the current backlog of piles on the unit.
- Minimum pile size, hand or machine created, shall be no less than 6 feet high by 6 feet wide.
• Maximum parabola shaped pile size, hand or machine created, shall be no greater than those specified below:
  ➢ If the piles are within ½ mile of an occupied home, the piles can be 20 feet high by 30 feet wide or up to 7,100 ft³.
  ➢ If the piles will be farther than ½ mile from an occupied home, the piles can be 25 feet high by 70 feet wide or up to 50,000 ft³.
  *Windrows are acceptable as long as they are less than 7,100 ft³ or 50,000 ft³, depending on their location.

• Piles shall be compact, dirt free, and constructed with existing and/or created slash material in a manner as to eliminate large air spaces within the piles to facilitate burning.
• If any created or existing slash must be moved more than 50 feet in a hand piling operation to meet minimum required pile size, lop and scatter.
• Hand piles shall not be located any closer than 35 feet from any private property boundary.
• Lopped and scattered material would not exceed 18 inches in height from the ground.
• Pre-treatment of hazardous fuels along control lines may occur within the broadcast burn area, prior to ignition, to help insure fire does not escape the intended boundary.
• A secondary burn boundary will be identified prior to broadcast burning.

Wildlife

General
• Lop and scatter slash within quaking aspen stands.
• Large conifers greater than 12 inches dbh that are legacy trees should not be cut or removed from the interior of quaking aspen clones.
• A minimum of 3 of the largest dead trees will be left per acre, clumped is preferred. Minimum of 8 inches dbh for lodgepole (except within patch-cuts and group selections) and minimum 12 inches dbh for ponderosa pine. Also leave and identify existing large snags and live trees being used by wildlife prior to implementation, through consultation with the Wildlife Biologist.
• If not already present on the ground or beetle dead trees are present, 5 green conifers per acre greater than 8 inches dbh will be felled and left per acre scattered is preferred. All felled leave trees would be limbed and have full contact with the ground.
• Ponderosa pine will be left as snags first, especially large diameter.
• In ponderosa pine and mixed conifer stands, consider Rocky Mountain juniper as leave trees.
• Except within sight distance of developed private property, developed recreation sites, trails, and main roads there should be an average of 1-3 hand piles left per acre in manual treatments.

Old Growth Stands
• Whether live or dead:
  o If no standing snags are present and there are fewer than 5 large dead and down logs present per acre, fell and leave on the ground at least 5 green trees ranging from 8-14 inches dbh. All felled leave trees would be limbed and have full contact with the ground.
Leave trees needed for wildlife purposes would be identified by Wildlife biologist in coordination with Silviculturist, Fuels Planner, and prep crews.

**Flammulated Owl**
- There should be no operations April 1 through August 30 for 1,300 feet surrounding owl nest sites.
- **Within Owl Territories:**
  - Small and medium sized trees (0 to 5 inches dbh) should be thinned to promote large-open grown canopies.
  - Large, open canopy trees should not be cut. This includes ridgelines.
  - Riparian areas should be manually treated to promote quaking aspen/cottonwood and other cavity trees. Felling should not injure these existing trees.

**Preble’s Jumping Mouse Habitat**
- If wetlands/riparian areas below 7,600 feet in elevation are identified within treatment units during project layout, they will be buffered by 300 feet, with no operations between May and October for Preble’s Jumping Mouse.
- Limited treatment could occur outside the limited operating period (LOP) with approval from Wildlife Biologist.

**Raptors**
- All units adjacent to existing raptor nests will be resurveyed the nesting season prior to implementation. This is to ensure that the birds have not moved their nests into an active unit.
- All raptor nest buffers will have no activity from March 1 through September 15 (depending on species) or until determined unoccupied by the Wildlife Biologist. This includes prep work. Access through buffers should be assessed by the Wildlife Biologist.
- If known nests become unoccupied, surveys will be conducted within at least 2 aerial miles of the old nest. Surveys will occur during the breeding season prior to any project activity.
- Outside of the breeding season from September 16 through February 28, limited thinning may be allowed within the buffer if determined necessary to help reduce the risk of losing the nest site to wildfire. The Wildlife Biologist will help design and approve treatment.

**Botany**
- Locations of sensitive plant species and species of local concern will be determined by a Forest Service Botanist and have designated buffers applied.
- All areas potentially impacted by proposed project activities that have not been surveyed for rare plants and that contain medium- or high-quality suitable habitat for sensitive and local concern plant species will be surveyed prior to project layout in the area.
- Restore ground cover using native seed or plants as practicable to meet revegetation objectives.
Noxious Weeds

- To minimize risk of noxious weed introduction and spread, require all equipment to be used for ground-disturbing activities for this project (not including service trucks or other vehicles that remain on roadways) to be cleaned, i.e., free of mud, dirt, plant parts, and seeds, or other debris that could contain or hold seeds, prior to entering the project area. All wheeled or tracked vehicles, including trailers, or other equipment entering constructed temporary roads shall be cleaned prior to entry to the project area. Equipment will be considered free of soil and other debris when a visual inspection does not disclose such material.
- For known weed occurrences and for any new noxious weed infestations found in or near units prior to or during implementation of fuels treatment, fuels implementation personnel will coordinate with the District Invasive Plants Coordinator to implement appropriate prevention measures, such as avoidance, treatment of weeds prior to fuels implementation, and/or additional equipment cleaning requirements, such as between infested and uninfested units.
- Coordinate with District Invasive Plants Coordinator to locate landings, staging areas, skid trails, burn piles, and other areas of severe soil disturbance to best reduce risk of spread of invasive plants.
- Comply with FS Rocky Mountain Region Order NO. 02-2005-01 requiring use of certified weed-free hay, straw, or mulch in all Forest Service activities

Social

- Notify landowners who own property adjacent to cutting units or access roads prior to fuels implementation activities.

Recreation

- Recreation infrastructure components shall be protected from damage from all treatment activities.
- Treatment units that already have off-road impacts and/or the potential for new and increased off-road vehicular use impacts are generally in areas that have a moderate or low slope angle (35 percent or less), and enough usable terrain to use the vehicle (four-wheel drive or all-terrain vehicle). These areas would be protected from further encroachment of motorized vehicles by creating a buffer zone of no treatment or modification of treatment between the road open for motorized travel and the treatment area, or by installing fencing or other barriers. Buffer zones should be wide enough (minimum 100 feet from edge of road) to discourage attempts at creating new routes. These areas would be identified with input from recreation staff and unit layout personnel prior to final unit boundary designation.

Scenery

- Unit boundary and tree marking: When located within two chains (132 feet) of the viewers on FS System, County, State or US roads, occupied buildings or designated
developed recreation sites all leave trees shall be painted on the side facing away from the potential viewer and follow Forest Service Standards.

- For all cutting units, achieve a natural appearing shape as determined by the Landscape Architect. Units shall mimic the scale of natural openings, unit boundaries shall utilize natural edges, and unit boundaries shall be laid out to prevent the appearance of uniform tree spacing and straight line unit boundaries. Straight line boundaries shall be treated by ‘feathering’ and ‘scalloping’, including along private property boundaries.
  - To ‘feather’ would be to go from a sanitation and removal cut or maximum thinned density to a higher stand density 50 to 200 feet from key visual features such as major roads and private property.
  - To ‘scallop’ would be to cut curvilinear edges of varying wavelength and amplitude for example, a short one followed by two long ones, and then a medium one, etc.

- All treatment areas would be reviewed by a Forest Landscape Architect prior to final unit layout.

- In mechanical treatments, burn piles should be located out of sight of significant viewpoints as designated by a Landscape Architect whenever possible within the constraints of the contract. In manual treatments, the Landscape Architect should be consulted.

- Visual Design Criteria for Prescribed Fire
  - Avoid burning activities during the growing season.
  - Use natural breaks for fire lines whenever possible (rock outcrops, meadows and wet areas, changes in vegetation type/structure/condition etc.)

- Closures for temporary road shall be with berms, revegetation, or with barrier rocks of various sizes and grouped in ‘natural’ arrangements and 1/3-1/2 buried.

Heritage

Mechanical Treatment Units

- A Class II (sample) Cultural Resource Inventory would be completed on all units designated for mechanical (other than chainsaw) thinning and quaking aspen enhancement, in consultation with the Colorado State Historic Preservation Office (SHPO) prior to project implementation. Implementation would not begin until the SHPO has concurred with a determination of no historic properties affected or no historic properties adversely affected.

- In accordance with the Programmatic Agreement Among the Advisory Council on Historic Preservation, The Colorado State Historic Preservation Office, and the USDA Forest Service Arapaho and Roosevelt National Forests and Pawnee National Grassland Regarding the Implementation of Bark Beetle Management, Hazardous Fuel and Tree Reduction Programs and Management of Cultural Resource Programs Within Hazardous Tree Environments (Bark Beetle PA) when sites that are evaluated as field eligible historic properties are located during the field inventory, no mechanical treatment would occur within the site boundary and a 50-foot buffer around the site. If treatment is necessary, these sites and a 50-foot buffer will be hand treated for hazard trees and accumulated fuel build up utilizing treatment options in Stipulation B of the Programmatic Agreement. No thinning, pile burning, or other slash treatments would
occur within these buffers unless determined to be appropriate by the Project Archaeologist.

- All NRHP eligible or unevaluated sites within the units proposed for mechanical treatments would be flagged on the ground for avoidance during implementation. Previously undiscovered sites encountered during the course of project activities would be avoided until they can be evaluated by an archaeologist. If affected properties are discovered after project activities are completed, the Forest would document any damage and consult with SHPO and Council pursuant to 800.13(b).

- Previously undiscovered sites encountered during the course of project activities would be avoided until they can be evaluated by an archaeologist. If affected properties are discovered after project activities are completed, the Forest would document any damage and consult with SHPO and Council pursuant to 800.13(b).

**Prescribed Broadcast Burning**

- A Class III (intensive) Cultural Resource Inventory would be completed on all areas within prescribed burn units that have been identified by the Project Archaeologist and Forest fire planners as being within the burn’s Area of Potential Effects and in areas of high potential for historic properties, as described in the Programmatic Agreement Among the Advisory Council on Historic Preservation, The Colorado State Historic Preservation Office, and the USDA Forest Service Arapaho and Roosevelt National Forests and Pawnee National Grassland Regarding the Implementation of Prescribed Broadcast Burning Program (Prescribed Fire PA). This inventory may be completed after the NEPA decision has been made but prior to burn implementation.

- All NRHP eligible or unevaluated sites located within prescribed burn units would be marked on the ground by the Project Archaeologist. The Project Archaeologist and fire staff would design protection measures to remove the sites from the burn’s Area of Potential Effects. These protection measures would take into consideration the site type, environmental setting, and anticipated burn conditions. These protections may include, but are not limited to: fuel breaks, no treatment buffers, wrapping, foaming, wetting, black line, fire line (machine or hand dug), and raking.

- All potentially ground-disturbing fire lines, staging areas, helispots, and all road improvement, construction or deconstruction, or designated ATV or vehicle routes/ways would be intensively (Class III) surveyed for cultural resources prior to project implementation; any NRHP-eligible cultural resources would be avoided by project design.

- Additional site protection measures may be required for NRHP-eligible or unevaluated sites located within the secondary burn area. These protection measures would take into consideration the site type, environmental setting, and anticipated burn conditions. These protections may include, but are not limited to: fuel breaks, no treatment buffers, wrapping, foaming, wetting, black line, fire line (machine or hand dug), and raking.

**Temporary Road Construction, Fireline Construction, and Skid Trails**

- In accordance with the Bark Beetle PA, when sites that are evaluated as field eligible historic properties are located during the field inventory, a 50-foot buffer around the site will be established. The construction will be moved to avoid the site and the 50-foot buffer area. If the undertaking consists of construction and there is the potential for unidentified buried cultural remains, the location will be moved to avoid the site and the construction activities in the area will be monitored by an archaeologist.
• Consultation with Native American tribes must be completed prior to the closure of roads to ensure that access to areas of cultural importance is not inadvertently removed.

Monitoring

Soils

Monitoring years 1 and 5 following implementation. Implementation and effectiveness monitoring is recommended. Monitoring should be conducted by ARNF Watershed Personnel and other key personnel from the Planning and Implementation Team. Specific monitoring items include:

• Mechanical Treatments: Slash retention for nutrient cycling and erosion control, decompaction, erosion control and re-vegetation of severely impacted landings, skid trails and temporary road, burn pile effects and recovery.
• Manual Treatments: Burn pile effects and recovery
• Broadcast Burn Treatments: Soil burn severity and post treatment erosion

Silviculture

The objective of monitoring for the silvicultural resource will be to:
1. Ensure that decisions made as a result of the analysis are implemented.
2. Determine the effects of vegetation management and related treatments identify adverse impacts and mitigate if necessary.

Summaries of accomplishments will be reported electronically in the FACTS database on the Arapaho and Roosevelt National Forest for upward reporting and district use.

Wildlife

Known raptor nest sites will continue to be monitored for occupancy and reproductive success at least until full completion of all project activities.

To ensure Forest Plan Effective Habitat requirements, monitor for effectiveness of all closed features (temporary roads, landings, and skid trails).

Noxious Weeds

Inspect project areas at highest risk for noxious weed infestation and/or spread at least once during the first three growing seasons after ground-disturbing operations, and determine treatment and further monitoring needs based on the results. The highest risk project areas are generally mechanically treated areas, particularly landings and other areas of heavy activity and/or where mineral soil is exposed; areas where piles have been burned; and areas where high priority weeds were already present.
Chapter 3 – Affected Environment and Environmental Consequences

Introduction

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

Direct and indirect effects of the proposed action and its alternatives were analyzed over the planning period (10-15 years). Cumulative effects differ from direct and indirect effects in that they take into account past, present, proposed, and reasonably foreseeable activities, in addition to direct and indirect effects, that could affect issues and resources. The area analyzed for cumulative effects is the project area for all resources unless otherwise noted. The Forsythe Project Area is located within portions of four 6th level watersheds – South Boulder Creek-Beaver Creek to South Draw, Middle Boulder Creek, Boulder Creek Forks to Fourmile Creek, and South Boulder Creek-Jenny Creak to Beaver Creek watersheds.

Past activities can have long-lasting and far-reaching effects regardless of whether they are active or passive in nature. Past activities or events that have been considered in the cumulative effects analysis include wildfires, timber harvest, livestock grazing, storms, insect infestations, residential development and fire suppression. Some of these activities and/or events have been affecting the area for over 100 years. A significant activity that has occurred in the past 100 years is fire suppression.

Establishment of mineral claims and homesteading has resulted in many tracts of private land throughout the project area especially along streams and draw bottoms. Much of this private land has been developed into subdivisions and/or residences. Roads were also built often along the easiest routes, generally in or parallel to drainage bottoms.

Past activities conducted by the Forest Service include the Winiger Ridge Ecosystem Management Pilot Project and timber stand improvement activities decades ago. Fuels treatment activities have occurred on private and Boulder County Parks and Open Space lands within the project area boundary. The construction of Gross Reservoir and associated facilities introduced disturbance and human use that facilitate weed introduction and spread. Past mining activity created disturbance and openings for weeds. All types of recreational use of the area continue to increase, with the potential to introduce and spread noxious weeds. Residential intermix is prominent in several areas including Nederland and along the main state and county roads in and bordering the area, and use of National Forest System lands by area residents is correspondingly high in and near these areas. Construction of new parking areas and camp sites in the Winiger...
Ridge and Forsythe areas, a cooperative project between Denver Water and the USFS, began in 2010 and is expected to be completed by 2012.

**Present activities** are those activities currently occurring within the project area boundary. Present activities include forest management activities, residential/subdivision development on private lands, and dispersed recreation. Recreational activities include camping, hunting, hiking, OHV use, motorbike and ATV riding, horseback riding, bicycling, and wildlife watching. The area has numerous trails and many roads (State, County, private, and National Forest roads). Additional present activities considered by the ID Team are discussed under the respected resource sections in this chapter.

**Reasonably foreseeable actions** include those management activities that are continuing or scheduled to occur within the next five to fifteen years or beyond. These activities may occur regardless of which alternative is selected for implementation. Foreseeable actions include continued livestock grazing and increased residential development on private lands. A continued increase in travel and recreation use is likely based on current trends. Vegetation treatment on public and private lands, suppression of wildfires and prescribed burning at various levels is likely to continue. Reasonably foreseeable future actions include the Moffat Collection System Project, which has been proposed by Denver Water Board and has a high likelihood of being implemented in a time frame that may overlap the Forsythe Fuels Reduction Project. Additional foreseeable activities considered by the ID Team are discussed under the resource sections in this chapter.

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

- Physical Environment
- Biological Environment
- Social Environment

**Physical Environment**

This section will describe the affected environment and environmental consequences for each resource of the Physical Environment (Soil, Hydrology, Fisheries, Air, and Fire and Fuels).

**Hydrology and Fisheries**

**Affected Environment**

**Watersheds**

The Forsythe project area encompasses portions of four watersheds. All the watersheds are within the Boulder Creek basin. The watersheds are listed in Table 3. Streams within the project area include South Boulder Creek, Middle Boulder Creek, Forsythe Canyon, and Winiger Gulch. Forsythe Canyon and Winiger Gulch are entirely within the project area, while the headwaters of Middle Boulder and South Boulder Creek are near the Continental divide to the west, and the streams flow through the project area.
Nearly half (49%) of the lands within the project area are private. While the Forest Service has considerable less information on watershed conditions and land use on private lands, these lands are often more developed and have higher densities of roads, buildings, and agricultural development than adjacent Forest lands.

A watershed condition assessment of all watersheds in the Forest was completed in 2011 using a nationally developed protocol (USDA Forest Service, 2011). The assessment considered conditions only on Forest Service (FS) lands within the watersheds. In that assessment, Middle Boulder Creek was rated in condition class 1-Functioning Properly. Boulder Creek Canyon and Middle South Boulder were rated in condition class 2-Functioning at Risk, and Upper South Boulder Creek was rated in condition class 3-Impaired Function.

While the Middle Boulder Creek watershed was rated as class 1 for FS lands, nearly the entire length of the creek through the watershed is located on non-FS lands. Impacts on non-FS lands include Barker Reservoir, which diverts flow from the creek throughout the year, and Highway 119, which parallels the creek from Boulder to Nederland. Elements of concern on FS lands included the absence of native fish, and forest health.

Boulder Creek Canyon is the watershed located below the confluence of Middle Boulder and North Boulder Creeks. Sixty-eight percent of the watershed is in non-FS ownership. The highway also parallels the creek through this watershed. Elements of concern identified for FS lands included the absence of native fish, road densities, noxious weeds and forest health.

Middle South Boulder Creek contains the largest portion of the project area. Twenty-five percent of the watershed is in non-FS ownership. Elements of concern identified for FS lands included the absence of native fish, road densities, noxious weeds and forest health. South Boulder Creek is affected by flow augmentation from the Moffatt tunnel. However, because of steeper gradients and a coarser, more resistant streambed, the stream has been less affected in this watershed than in the watershed upstream.

Upper South Boulder Creek contains the smallest portion of the project area. Fifty-two percent of the watershed is in non-FS ownership. Elements of concern identified for FS lands included water quantity, water quality, the absence of native fish, road densities, and riparian vegetation. As noted above, South Boulder Creek is affected by flow augmentation from the Moffatt tunnel. Increased flows and channelization have adversely affected channel stability and morphology, as well as aquatic and riparian habitat. Historic mining in tributaries continues to affect water quality.
Table 3 - Watershed ownership, condition class, and road density.

<table>
<thead>
<tr>
<th>Watershed (WS) Name</th>
<th>WS HUC6 #</th>
<th>WS Acres</th>
<th>Percent of Watershed within Project Boundary</th>
<th>Watershed Condition Class*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Middle Boulder Creek</td>
<td>101900050402</td>
<td>28,346</td>
<td>12%</td>
<td>2</td>
</tr>
<tr>
<td>Boulder Creek Canyon</td>
<td>101900050404</td>
<td>9,787</td>
<td>23%</td>
<td>2</td>
</tr>
<tr>
<td>Upper South Boulder Creek</td>
<td>101900050502</td>
<td>26,135</td>
<td>6%</td>
<td>3</td>
</tr>
<tr>
<td>Middle South Boulder Creek</td>
<td>101900050503</td>
<td>25,647</td>
<td>42%</td>
<td>2</td>
</tr>
</tbody>
</table>

*Based on WCC ratings of FS lands only, (USDA-FS, 2011)

Water Quality
The State of Colorado Water Quality Control Commission has designated the streams within the analysis area as Cold Water Aquatic Life Class 1, Recreation Class 1, Agriculture, and Domestic Water Supply. This indicates that the waters should be capable of sustaining a wide variety of cold-water biota, including sensitive biota; are suitable for direct contact recreational activities; are suitable for direct agricultural irrigation; and are suitable for potable water supplies following standard treatment (Colorado DPHE, 2006). Gamble Gulch, a tributary to South Boulder Creek upstream from the project area is listed on the 2010 303(d) list as impaired because of high cadmium levels. (Colorado DPHE, 2010)

Hydrology
Stream flow patterns in the project area are typical of those found in snow-dominated watersheds along the Front Range of Colorado. The annual average precipitation in the Forsyte area is 20-22 inches (PRISM, 2011). Most of the precipitation falls in the spring and summer. The wettest months of the year in the area are April and May. Stream flow rises in April or May as snow begins to melt and peak in May or June. Flow declines through the summer and fall. Low, stable base flow occurs through late fall and winter, until snow begins to melt again the following spring. South Boulder Creek is the receiving stream for water imported from the Colorado River Basin through the Moffat Tunnel. The stream is used as a conduit to fill Gross Reservoir with the imported flow. The operation of this system has greatly increased flows in South Boulder Creek, particularly in the spring and summer months.

The most persistent impacts to aquatic habitats from management are related to stream augmentation in South Boulder Creek and to road management, specifically sediment accumulation in streams where roads are hydrologically connected to streams. Although legal access to FS roads within the parcels proposed for treatment is limited, road networks, system and non-system, are quite extensive, particularly on FS lands adjacent to Gross Reservoir. There are 110 miles of inventoried roads within the 28.3 square mile project area (Kittson, 2011). This equates to a road density of 3.89 miles per square mile, which is high compared to other areas of the Forest. Actual road densities may be higher, because most private roads and driveways are not mapped. Moderate amounts (1443 acres) of past vegetation management have occurred in different portions of project area watersheds over the past 20 years. These timber harvests and forest management projects included some construction of roads, alteration of hydrologic pathways, and impacts to aquatic habitats.
Aquatic Ecosystems
Aquatic ecosystems are subjected to varying levels of stream flow and sediment fluxes, depending on the type of disturbance that occurs and the vegetation within the area. Aquatic ecosystems in ponderosa pine historically have been subjected to frequent low intensity fires with minor flooding and sediment delivery yields following a wildfire. In recent history, fire suppression in ponderosa pine stands has resulted in heavier fuel loading and higher wildfire risk. In lodgepole pine forests, fires have historically been less frequent, but more intense and stand replacing. This has resulted in more significant flooding and erosion events following wildfires.

High severity fires increase risk of flooding, which can lead to more erosion and sedimentation than with low and moderate severity fires. Where fire suppression has allowed ponderosa pine stands to become denser, fires may result in stand replacing burns. Human uses such as roads, habitation, and recreation have introduced sources of chronic, lower level watershed disturbance and sedimentation into portions of the project area.

The Forsythe Project area has several perennial streams within its boundary, including South Boulder Creek, portions of Winger Gulch, Forsythe Creek, and South Beaver Creek. Some portions of Winger Gulch, upper Forsythe Creek, and several unnamed tributaries streams are intermittent, yet contain perennial pockets of water. South Boulder Creek within the vicinity of the project area runs through a moderately confined valley with sustained sections of steep, cobble-dominated streambed. South Boulder Creek was historically occupied by greenback cutthroat trout; however, this species was locally extirpated by the early 1900’s and replaced by rainbow trout through aggressive fish stocking programs. Rainbow trout remained the primary fish in South Boulder Creek and several other front range streams up until recent history (e.g., rainbow trout were 66% of catch in 1991 in South Boulder Creek at Pinecliffe [CDOW 1991]) when whirling disease collapsed most rainbow trout populations in Colorado. South Boulder Creek is currently managed by Colorado Parks and Wildlife as a coldwater fishery primarily for brown trout, but the stream is also inhabited by longnose suckers, white suckers, and other introduced stream salmonids. The reach of South Boulder Creek entering Gross Reservoir hosts a fall run of kokanee salmon that use cobble-riffles to spawn.

Gross Reservoir is a 440 acre reservoir owned by Denver Water and serves as a lake-based cold-water fishery managed by Colorado Parks and Wildlife. The reservoir hosts a mixture of introduced and native fish species, including two native suckers, longnose (Catostomus platyrhynchus) and white (Catostomus commersoni). Colorado Parks and Wildlife has stocked brown trout, rainbow trout, splake, kokanee, tiger muskie, lake trout, and cutthroat in the reservoir in recent years, 2007 to 2010 (Swigle 2010). Native suckers comprise roughly two-thirds of the fish community in Gross Reservoir and are persisting well in both South Boulder Creek and Gross Reservoir. CPW is currently stocking large predatory tiger muskie in order reduce the sucker composition to half of the total catch, thereby providing room for additional game fish (Swigle 2010).

Brown trout are considered a Management Indicator Species (MIS) for montane aquatic environments on the Arapaho & Roosevelt National Forest. Although this project area is within the historic range of the greenback cutthroat trout, a fish species listed as threatened under the
Endangered Species Act, these fish no longer occur in South Boulder Creek. In addition, there are no known populations of Sensitive Aquatic Species present within the project area, South Boulder Creek and its tributaries adjacent to and downstream of the project.

South Boulder Creek flows through a forested riparian area, yet large wood from fallen trees contributes relatively little to channel complexity and stability due to in part to flow augmentation from the Moffat Tunnel transbasin water diversion. Rather, the stream has a relatively coarse streambed and has been armored (i.e., smaller particles have been washed away) resulting in a stable streambed, with moderate to low levels of habitat complexity. South Boulder Creek within the project area is inhabited by longnose sucker, white sucker, brown trout, eastern brook trout, and non-native cutthroat trout.

Winiger Gulch, Forsythe Creek, and South Beaver Creeks are much smaller in size and have typical hydrographs for streams of their size and elevation. Lower portions of Winiger Gulch, Forsythe Creek, and some tributaries are perennial, but have modest peak flows and relatively low stream power. Aquatic habitats in these streams are follow a pool-riffle sequence and streambeds are comprised of a mixture of sands, gravels, cobbles, and bedrock (USDA Forest Service 1989, 2011). Within these smaller streams, inputs of large wood (i.e., fallen spruce, fir, pine, cottonwood, and quaking aspen) occur sporadically and when present, wood provides considerable channel stability and habitat complexity. Although the most recent fish surveys suggest that Winiger Gulch and Forsythe Creek are fishless (CDOW 1989), fish surveys were not actually performed. Based upon our observations, these streams do contain enough water to support low-density populations of stream salmonids. Macroinvertebrates species belonging to plecoptera (stoneflies) and trichoptera (caddisflies) occur in these streams (CDOW 1989) and in temperate, cold-water streams have life-cycles exceeding 1 year (Thorp and Covich 2001), indicating that they have year-round stream flow. Head water aquatic habitats in these small streams support a thin ribbon of riparian vegetation that varies from spruce to quaking aspen to sedges and other riparian plant species. Other unnamed streams in the project area are not perennial and do not support the same aquatic habitats as described above, but do support pockets of riparian vegetation. Over the next few decades, an increase in large wood loading may occur along portions of stream that run adjacent to lodgepole and ponderosa pine forest; however, we are uncertain at this time whether or not these additions would be outside of the range of natural variability.

Granitic soils are more erosive and produce higher levels of sedimentation than soils developed from other geology (e.g. metamorphic or sedimentary) (Megahan and Ketcheson 1996). Although granitic geologies often give rise to more fine-textured streambeds, our survey data indicate that these streams are capturing and storing more fine sediment than they have the capacity to transport and are out of balance. Many segments of streams in Winiger Gulch and Forsythe Creek have high amounts of fine sediment deposition in the streambed. The dominant source of elevated fine sediment in streams is erosion from streamside roads.

High rates of fine sediment deposition in streams can alter streambed composition, stress the macroinvertebrate community, and severely limit macroinvertebrate diversity and abundance (Waters 1994). Macroinvertebrate diversity and abundance increases with median particle size, particularly in mountain streams, and this cause-effect relationship holds true in the reverse
direction when particle size is reduced due to anthropogenic stream sedimentation (Erman and Erman 1984, Waters 1994, Kaller and Hartman 2004). Within the project area, survey crews observed several common orders of stream macroinvertebrates (e.g., ephemeroptera, plecoptera, tricoptera, coleoptera, diptera) at most, but not all, stream habitats surveyed. Macroinvertebrates were not observed at Forsythe site #5, where the streambed had been turned into hard pavement and native cobbles had been completely embedded with road-derived sediments (<2mm). Over the last 20 years, the overall size range of streambed particles has become reduced and median particle size \((D_{50})\) has been reduced by half in the lowest reach of Winiger Gulch. Thus, the current trend for stream macroinvertebrate communities in Winiger and Forsythe watersheds is negative and lower species diversity and reduced abundance is likely in the future if road sedimentation continues at the current rates.

The typical conditions of the Forest Service roads within the project area are poor (Kittson 2011). Roads surrounding Winiger Gulch and Forsythe Creek are used by four-wheel drive enthusiasts, lack sufficient drainage, and are actively contributing sediment to the interconnected stream networks (USDA Forest Service 2011). Watershed crews surveyed and mapped erosion risks and sources along all Forest Service system roads in the project area in 2011. Eroding and rutted road surfaces, eroding cut and fill slopes, and gullies down and across road surfaces were common on system roads within the project area (Figure 3) and sources of road erosion were generally well-connected to the stream network. Road assessments from 1998 indicate that road conditions have been poor for the last 13 years. Assessments were repeated in 2011 and indicate that road conditions have continued to deteriorate (see Figures 4 & 5). Road densities are high and roads have numerous hydrologic connections to streams due to poor location, design, and lack of surface/ditch drainage. Observations from the watershed crew and specialist reviews indicate that eroding road surfaces, cut slopes, and fill slopes in the project area are the primary sources of the abnormally high fine sediment loads found in the small streams, such as Winiger Gulch and Forsythe Creek. Unpaved county roads may also be contributing fine sediment to these streams on an annual basis.

As a result of the nearly continuous sediment supply, sediment is currently being delivered to Gross Reservoir at the inlets of South Boulder Creek, Winiger Gulch, and Forsythe Creek. Due to low sediment transport capacity in the latter two streams and the steady volume of sediment supply from unsurfaced roads, sediment is being stored in Winiger and Forsythe that will be delivered to the reservoir during flood events or during periods of unusually heavy spring runoff.

**Desired Condition**

The desired watershed condition for the analysis area following management activities includes having stable soils capable of supporting vegetative growth and minimizing erosion, streams with stable channels, a healthy riparian community, appropriate assemblages of aquatic fauna in each aquatic habitat, and the ability for the watersheds to transmit the expected range of water and sediment. Streams should provide the physical habitat necessary to support populations of native and desirable non-native fish and macro invertebrates. Where floodplains are present, they should be connected to the stream channels. Pathways that connect upslope disturbed areas to the stream channels should be minimized.
Alternative A – No Action

Direct and Indirect Effects

Direct Effects
Under the no action alternative, no vegetation management activities to reduce hazardous fuels in the Forsythe project area would occur and no road construction would occur, which would result in no additional impacts to soil, water, or fisheries resources. Because no ground disturbing activities would be implemented (including creation of new roads, skid trails and landings), no additional direct effects such as compaction (rutting), removal of ground cover (decrease in surface organic matter content), decrease in nutrient levels, increase in erosion and runoff potential would occur. Organic material would continue to accumulate and decompose at natural rates. Recovery in previously and currently impacted areas would continue a natural rate. However, excessive sedimentation from existing roads would continue to impact streams and aquatic habitats. Reduction in road erosion and stream sedimentation through natural recovery is unlikely to occur. Future reclamation projects could be planned for the area to eliminate erosion from existing impacted areas.

Because there are no known Federally Listed or Forest Service Sensitive fish or aquatic species, the effects determination for this project is limited to the Forest’s Management Indicator Species, in this case, brown trout. Effects to brown trout are expected to negligible as a result of the No Action Alternative. Brown trout are currently in a stable to increasing trend across the Forest and stable in South Boulder Creek. These population trends are expected to remain unchanged under the No Action alternative.

Indirect Effects
The selection of the No Action alternative would result in no indirect effects from slash disposal activities such as pile and burn, chipping, mastication and lop and scattering. Over time, this may lead to an increase in the fuel accumulations within the project area. Increased fuel accumulation may at some point lead to higher severity fire should a wildfire occur and would potentially reduce the opportunity for fire crews to engage the fire for suppression. More intense fire behavior could also increase the soil burn severity effects, including water repellency and soil loss potential. In addition, there would not be any new road construction or road reconstruction in the project area. Soil erosion, watershed impacts, and ensuing effects on aquatic habitat would not occur as a result.

Cumulative Effects
Cumulative effects to hydrology and fisheries resource initiated by management activities in the project area, including streamflow augmentation, recreational use, and travel on existing roads and trails would continue. Streams within the project area would continue to receive sediment loading of fine material from erosion generated by these activities. Aquatic habitat, fish populations (South Boulder Creek & Gross Reservoir), and macroinvertebrates within the project area (Winiger Gulch, Forsythe Creek, and South Beaver Creek) would continue to remain relatively stable. Self-sustaining populations of management indicator species, brown trout, would persist in areas where they currently exist.
Except for roads, watersheds have largely recovered from past management activities. Eroding road surfaces would continue to deposit fine sediment into Winiger Gulch and Forsythe Creek at current rates. We modeled a subset of existing road segments within the project area. Based on our calculation of 1.4 miles of eroding road surfaces in the project area, the estimated annual sediment yield into Winiger Gulch from these road segments is 35.7 cubic yards of fine sediment (USDA Forest Service FS WEPP Model 2009). As a result of this high annual sediment load, the abundance, diversity, and production of aquatic macroinvertebrates would continue to be repressed and in some cases increasingly absent from habitats that they would be expected to occupy (see Affected Environment). Tree mortality resulting from the ongoing bark beetle infestation is expected to increase in the project area within the immediate and foreseeable future (1-15 years), and may temporarily increase the probability for more intense fire behavior.

Cumulative impacts to fisheries, hydrology, and soil resources are expected to be less than Alternative B primarily because there would be no heavy equipment operation in units and no new road construction.

**Alternative B – Proposed Action**

**Direct and Indirect Effects**

Effects to watershed and fisheries resources are primarily based on potential impacts from ground-disturbance and road construction. This includes the potential for sediment eroding into streams and lakes (thus disrupting the aquatic environment), and compaction of wet soils with subsequent impacts possible to the hydrologic flow regime. Changes to aquatic habitat, fish populations, hydrology and soils would be expected, especially in aquatic habitats adjacent to road construction and road reconstruction activities as well as where mechanical treatments are implemented. Mitigations are provided in the Project Design for Watershed & Fisheries Protection section of this report. These measures have been shown to reduce sedimentation and other impacts affecting watershed and fisheries resources when compared to un-mitigated actions.

Under Alternative B, fuels reduction would be accomplished on 4,560 acres. The proposed treatments include mechanical harvests (clear-cutting to thinning), hand-thinning, and broadcast burning. Project planning has not been precise enough to describe the exact number of acres of mechanical treatment. For the analysis, we have assumed that the total acreage for mechanical treatments is equal to the acres of proposed treatment in lodgepole and ponderosa pine stands, which is 3,908 acres; however, a primary design feature would limit equipment operation to slopes less than 40%. Because slopes greater than 40% occur within some units the actual acreage of mechanical treatment may be less than 3,908 acres. Access to the proposed units would be from existing roads and trails where practicable; however, there would be substantial road construction and road reconstruction (widening roads, improving surface drainage, and building passing lanes) to make the existing roads usable for conventional harvesting equipment. Currently, the mileage of road reconstruction is unspecified due to uncertainty with how units would be marked on the ground. Approximately 10 miles of temporary roads would be constructed for unit access. The following table shows how the fuels treatment areas would be distributed across the project area watersheds.
Table 4 - Alternative B Proposed Treatments by Watershed.

<table>
<thead>
<tr>
<th>Watershed Name</th>
<th>Watershed No.</th>
<th>Watershed Acres</th>
<th>Acres Proposed for Harvest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boulder Creek Canyon</td>
<td>101900050404</td>
<td>9,787</td>
<td>116</td>
</tr>
<tr>
<td>Middle Boulder Creek</td>
<td>101900050402</td>
<td>28,346</td>
<td>860</td>
</tr>
<tr>
<td>Middle South Boulder Creek</td>
<td>101900050503</td>
<td>25,647</td>
<td>3085</td>
</tr>
<tr>
<td>Upper South Boulder Creek</td>
<td>101900050502</td>
<td>26,135</td>
<td>352</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>4,413</td>
<td></td>
</tr>
</tbody>
</table>

For the Middle South Boulder Creek watershed, 650 acres of the total acreage listed below would also be treated by broadcast burning. There are an additional 315 acres of broadcast burning to occur in the Middle South Boulder Creek watershed not included in the table.

Vegetation management has the potential to impact streams and aquatic habitats. Potential adverse impacts include increases in erosion and sedimentation, compaction, and vegetation loss in wetlands and riparian areas. Typically it is not tree cutting that directly produces the adverse impacts, but rather the ground disturbance, soil compaction, and routing of water and sediments to stream/riparian networks that can cause damage to watershed and fisheries resources. The primary activities that pose risks to watershed and aquatic resources is the operation of mechanized equipment and the ground disturbance related to burn piles necessary to treat the slash. However, project design features to protect aquatic resources, shown in chapter 2, would greatly reduce the risk of these adverse effects.

**Mechanical Treatments:**
Mechanical vegetation management can increase soil compaction, cause ground disturbance, and increase the risk of erosion and sedimentation. In addition, downhill tractor-yarding can lead to rill erosion, extend stream networks, and route eroded sediments into streams particularly when done in close proximity to stream channels. Impacts to watershed resources and aquatic habitats have the greatest potential to occur in units with stream and riparian features (units PP6, LP11, PP11, LP12, LP16, PP19, and PP21).

Direct and indirect effects to watershed resources related to specific mechanical activities are analyzed separately as follows:

a. **Patch-cuts/Group Selections** in lodgepole pine, Sanitation and Salvage treatments in all pine types – Perennial streams occur within the boundaries of several units that would be harvested for timber removal. Erosion potential (and runoff values) could increase especially in steep areas of units if the remaining area is mostly bare soil. Depending on the proximity to streams, layout of skid trails, and buffer effectiveness, impacts to streams and riparian habitats could potentially occur (runoff and routing of sediment into streams via skid trails); however, it is the intent of the project to minimize potential effects through the effective use of design features. Based on our examination of riparian buffer topography, ground cover, and infiltration capacity of granitic soils, we expect that some of the sediment yield would be captured and stored in the riparian buffers. Due to the presence of steep draws and drainages in some of these units, there is some risk that sediment yield from units would be routed into...
stream channels. Monitoring would be used to determine the implementation and effectiveness of design features.

b. Heavy Equipment operation - The use of mechanical equipment could generate an increase in soil compaction and rutting of the hillslope where skid trails occur. These ground disturbances could result in higher erosion and runoff values. These negative effects are expected to occur primarily within skid-trails, landings, and temporary roads. It is the intent of the project to minimize the effects of skidding, processing, masticating, and other equipment operation through the use of design features such as limiting passes and turns, designation of landings and skid trails and restoration of disturbed areas. Erosion and runoff may occur during snowmelt or storm events. In the short term, erosion would increase during and following the project activities due to removal of ground cover and vegetation.

c. Slash disposal: Pile and Burning, Chipping and Mastication: Burn piles leave patches of bare disturbed soils following the completion of the burn. The effects to soils of burn piles are more thoroughly documented in the soils report. Because burn piles are typically surrounded by areas with less disturbance and more intact ground cover, the risk that sediment produced from soil erosion would be introduced to streams is usually low. However, if burn piles are located in areas that have been mechanically disturbed (e.g. landings) and pathways such as skid trails have been created that link the burned areas to streams, the burn piles can become a source of sedimentation. To address these concerns, project design will be implemented to keep burn piles 50 feet from perennial streams, wetlands, fens, and wet meadows. While chipping and mastication can have both beneficial and adverse effects to soil chemistry (see soils report) and can suppress revegetation, their effects to physical watershed processes are beneficial. Chipping and mastication replenish ground cover that has been lost due to harvesting and reduce the risk of erosion and sedimentation.

**Thinning**

Around 9 percent (505 acres) of the Forsythe Fuel project units would be treated by ground crews felling trees with chainsaws (hand-treatment) for meadow enhancement and quaking aspen restoration. With the exception of burn pile effects, there are generally few effects (minimal ground disturbance) to watershed and aquatic resources associated with hand fuel reduction treatments, provided an adequate amount of fine slash, litter and duff (organic matter and ground cover) is retained and maintained in the activity area.

Hand treatment units are proposed primarily in areas with slope gradients less than 40%, but some areas have gradients of greater than 40%. Hand treatment units should have minimal watershed impacts because foot traffic typically does not create sufficient ground disturbance to create the adverse impacts described above. Project Design that limit the amount of ground cover lost would limit the number of burn piles that can be constructed on steep slopes.

Hand treatments would also occur in some riparian areas of Winiger Gulch and Forsythe Canyon. Treatments would be limited to protect riparian shading and bank stability. Based on project design, no more than 50% of the overstory of trees would be removed within riparian areas, and trees growing on or near streambanks would be favored for retention. Retention of 50% of the forested canopy should prevent stream temperatures in the perennial aquatic habitats
from rising or otherwise being altered. The requirement to service and fuel equipment outside of riparian areas would avoid potential fuel/oil spills near water.

**Broadcast Burning**
Where prescribed burning is proposed, vegetative recovery would be expected to be rapid if burn intensities are low to moderate, with erosion rates typically dropping to pre-fire levels within 1-2 years in grass and up to 3 years in forested areas. Hydrologic recovery after fuel treatments also tends to be more rapid than after wildfire or where high severity fires occur because a smaller proportion of the forest canopy would be removed (Robichaud et al., 2006). Areas with high fuel loadings within the unit could experience higher soil burn severity, which could increase the potential for erosion and runoff movement following the burn. Due to coarse textured soils in burn units, there is a moderate risk of increased sediment yield to Winiger Gulch and Gross Reservoir since the proposed burns are located just upslope from the gulch and reservoir. Project Design limits the amount of area that can be in unrecovered burned area before more burning can be accomplished. Erosion rates are expected to return to baseline levels.

**Roads and access trails:**
There are no new permanent roads proposed for this project. Approximately 10 miles of temporary roads would be constructed to access multiple mechanically-harvested units. Temporary roads and skid trails would be identified during layout in a manner to minimize hillslope erosion and the number of stream crossings. In general, most streams are crossed by an existing network of system roads. While most temporary road construction would be mid-slope or ridge top roads, some temporary roads would be constructed near streams and a few new stream crossings are anticipated. Each additional temporary road crossing would result in increased sedimentation to the stream (Gucinski et al. 2001). Although temporary roads would be obliterated at the end of the project, they may remain open for several (up to five) years until fuels mitigation work is completed. During this time, they will continue to serve as a source of erosion and sedimentation. Rates of erosion are expected to be highest in the year of construction, and are expected to decline in subsequent years (Megahan et al. 2001).

Portions of the existing road network would be reconstructed. As with temporary road construction, erosion and sedimentation is expected to increase in the year following reconstruction (Megahan et al. 2001, Luce and Black 2001). Risk that sediment will enter stream channels is greatest for streamside roads and at stream crossings (Figure 6). Sediment yields should decline in subsequent years. If reconstruction leads to improved drainage and reduced erosion from the road surface, sedimentation rates from reconstructed roads should decline for those improved road segments in the midterm (2-10 years) (Burroughs and King 1989). Periodic maintenance could be used to extend this improvement.

Given the current high road-related sedimentation rates into Winiger Gulch and Forsythe Creek, we developed a comparative analysis of sediment yield from selected road segments in the project area that would likely be reconstructed. Using the Forest Service Water Erosion Prediction Project Roads Module (USDA Forest Service 2009), we generated annual sediment yield predictions for the No Action and Proposed Action Alternatives. The results are shown in Table 5. Temporary roads that cross streams or are constructed adjacent to streams would contribute similar yields to those presented in Table 5.
Table 5 - Comparison of the Rates of Annual Sediment Yield from selected road segments in Project Area for No Action alternative, Proposed Action alternative, and 10 year post-treatment scenarios. (Data derived from the FS WEPP: Road Interface and GIS data.)

<table>
<thead>
<tr>
<th>Road</th>
<th>Stream</th>
<th>Modeled Length (ft)</th>
<th>Modeled Yield (yds)</th>
<th>Eroding Distance (ft)</th>
<th>No Action Yield</th>
<th>Proposed Activities</th>
<th>Proposed action Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>359.1</td>
<td>Winiger</td>
<td>729</td>
<td>2.1</td>
<td>729</td>
<td>2.1</td>
<td>None</td>
<td>2.1</td>
</tr>
<tr>
<td>FSR 97</td>
<td>Winiger</td>
<td>873</td>
<td>0.6</td>
<td>4719</td>
<td>3.2</td>
<td>Reconstruct</td>
<td>5.2</td>
</tr>
<tr>
<td>349.1C</td>
<td>Tributary to Winiger</td>
<td>930</td>
<td>1.1</td>
<td>1523</td>
<td>1.8</td>
<td>Reconstruct</td>
<td>0.5</td>
</tr>
<tr>
<td>349.1</td>
<td>Winiger</td>
<td>322</td>
<td>0.3</td>
<td>322</td>
<td>0.3</td>
<td>Reconstruct</td>
<td>0.3</td>
</tr>
</tbody>
</table>

**Effects to Aquatic Species**

Because there are no known Federally Listed or Forest Service Sensitive fish or aquatic species, the effects determination for this project is limited to the Forest’s Management Indicator Species, in this case, brown trout and potentially brook trout. Aquatic habitats and aquatic life would be affected indirectly by the additional deposition of sediment yield generated as a result of the proposed action. Sediment yields would be most affected by road construction and reconstruction activities. These impacts would occur in Winiger Gulch and Forsythe Creek and ultimately contribute sediments to Gross Reservoir. Risk of sediment-related impacts is negligible for South Boulder Creek due to the absence of project-used roads crossing the stream and proximity of units to this stream (>500 feet). Although addition sediment would be deposited into Gross Reservoir at the inlets of Winiger and Forsythe, this would not likely affect how brown trout use habitats in the reservoir. Because impacts to South Boulder Creek and Gross Reservoir are inconsequential for fish, the effects to brown trout, as a Management Indicator Species, are expected to be minimal as a result of implementing the proposed action. Brown trout are currently in a stable to increasing trend across the Forest and within South Boulder Creek are stable. These population trends are expected to remain stable under the Action alternative.

Additional sedimentation into Winiger Gulch and Forsythe Creek would further reduce habitat diversity and productivity for potential fish and macroinvertebrates by filling pools (Bjornn 1977), filling of interstitial spaces (Bjornn and Reiser 1991, Waters 1994), and reducing streambed diversity (Waters 1994). These habitat changes in these streams would likely lead to a loss of stream insect diversity (Erman and Erman 1984, Beisel et al. 2000), loss of benthic macroinvertebrate abundance (Richards and Bacon 1994, Kaller and Hartman 2004), and loss of stream productivity (Cardindale et al. 2000). Projects with similar increases in sediment yield and deposition as driven by road construction activities have been documented to cause the changes in stream habitats listed above as well as some of impacts to aquatic life (Cover et al. 2008). The degree and duration of these impacts is dependent upon the number of new stream crossings, effectiveness of riparian areas to filter out sediment, the time that temporary roads are present and contributing sediment to streams, and the effectiveness & permanency of road obliterations. If the road network returns to its current size and number of stream crossings, then habitat conditions would eventually return to current conditions or perhaps even better. If this assumption holds true, then potential losses to macroinvertebrate diversity and abundance would likely return to current states within 5 to 10 years of completing the project.
Cumulative Effects

Cumulative watershed effects are considered at the scale of the four watersheds that contain the project area. They are Middle Boulder Creek, Boulder Creek Canyon, and Upper and Middle South Boulder Creek. Cumulative effects include historic and ongoing activities as well as future activities. The primary activities that contribute to watershed and aquatic cumulative effects include water conveyance and storage, roads, and residential and commercial development on private lands. Water conveyance and storage activities include storage in Gross Reservoir on South Boulder Creek and Barker Reservoir on Middle Boulder Creek. Flow augmentation from the Moffatt Tunnel greatly increases flow in South Boulder Creek. Diversions at Barker Reservoir for the Boulder power pipeline greatly diminished streamflow in Middle Boulder Creek. As noted above, road densities are high in all of the watersheds, and are a primary source of anthropogenic sediment into streams and waterbodies. Development on private land can serve as an additional source of sediment as well as a potential source of other pollutants. It is likely that this project would contribute to cumulative effects for stream sedimentation because of road construction and reconstruction.

Soils

Affected Environment

Geology, Soil Parent Materials and Physical Processes

The geology of the Forsythe Analysis Area (FAA) consists of rocks igneous intrusive origin. The geologic map unit Xg (Granitic rocks of 1,700-m.y. age group) covers most of the area. Geologic map units are Tgv (Bouldery Gravels on Old Erosion Surfaces) and Xb Biotitic gneiss, schist, and migmatite. On upper hill-slopes and ridgelines, soils are formed in residual parent materials (bedrock). On lower hill-slopes and valley bottoms, soils are formed in colluvial or alluvial deposited parent materials. In the FAA, rock weathering and soil formation is relatively slow and uplands soils are generally shallow, coarse textured and have high rock content.

In the absence of natural or anthropic disturbance, natural rates of erosion are typically low on forested FAA hill-slopes due to high litter, duff or vegetative ground cover. Soil erosion is accelerated by ground disturbing activities or features that remove protective ground cover or alter runoff rates. Currently, most of the soil erosion in the FAA appears to be occurring on roads and trails. Other infrequent and episodic natural erosion processes are landslides and debris flows. Hill-slopes in the area are not generally highly susceptible to mass wasting so landslides are not common. Debris flows and rock falls are far more common than landslides, particularly following wildfire.

Climate Zones and Aspect

The most of the FAA occurs in the Lower Montane and Montane climatic zones. Small areas of sub-alpine occur as elevation increases towards the eastern part of the analysis area. North facing aspects are typically Montane while south facing aspects are Lower Montane. Within the Lower Montane and Montane, north facing slopes are generally densely forested while south facing slopes feature open forests with understory vegetation in the form of grasses and forbs.
Within the FAA, climatic zone and aspect influence the degree and extent of project related effects, potential wildfire effects and natural recovery of disturbed areas.

Existing Conditions - Soil Properties and Interpretations
The FAA is covered by 15 Ecological Land Units, most of which repeat multiple times to total 153 mapped soil polygons within the analysis area boundary. The most common upland soil order in the FAA is Inceptisol. Typic Ustochrepts generally occur on south facing slopes and Lamellic Eutrocryepts generally occurring on north facing slopes. The central concept of the Inceptisol is minimal soil development with weak definition of soil horizons. Within the FAA, Inceptisols are generally shallow and have high rock content and thin surface horizons.

Generally, these soils are not highly susceptible to deep compaction but are sensitive to ground disturbing activities that impact protective ground cover and/or the surface layer of soil. The most common soil order within the valley bottom areas of the FAA is the Mollisol. Typic Haplustolls and Pachic Argiborolls are mapped. The central concept of Mollisols is a thick and dark colored surface layer. These soils are susceptible to compaction and rutting. They are not highly sensitive to prescribed fire effects.

Detailed descriptions of FAA soil properties, qualities, and limitations are available in the Soil and Terrestrial Ecological Land Unit Survey-Draft (USDA Forest Service, 2001) and through the Web Soil Survey (http://soildatamart.nrcs.usda.gov).

Forsythe Analysis Area Soils: Properties and Interpretations
For the purposes of this analysis, specific soil properties and interpretations were selected to describe project area soils and potential project related effects on soil hydrologic function and ability to support plant growth. Rates of natural re-vegetation and soil recovery following disturbance depend on many variables including type of vegetation, climatic conditions, severity of disturbance, and soil properties. These properties are described below.

Summary of Forsythe Soil Properties
Generally, soils occurring on FAA forested hill-slopes and ridge-tops (uplands) are shallow, rocky, have sandy loam surface textures. Additionally, most have thin surface layers and low water and nutrient holding capability. These sites are not usually highly susceptible to deep compaction but surface compaction of highly traveled areas has been observed on similar soils on other project areas. The soils have high potential for erosion if protective ground cover is removed and are particularly susceptible to loss of productivity if the organic (dark) portion of the surface layer is displaced or removed. Riparian area soils and vegetation, and/or seasonally wet soils are highly susceptible to damage caused by operation of heavy equipment or other vehicular traffic. Wet soils, steep slopes, rocky soils, and rock outcrops create moderate to severe limitations for road construction, heavy equipment operation, and other forest management activities throughout the project area.

Following soil disturbance, natural re-vegetation and recovery is a slow process in uplands soils of the FAA. Re-vegetation is slowest where soils are shallow, sandy, rocky, and/or where soil moisture availability limits vegetative growth. Climatic variables, particularly precipitation (moisture availability) and temperature (short growing season), also limit disturbed site recovery and re-vegetation processes. Due the resilient nature of uplands soils, disturbance from forestry
operations commonly lowers, but does not permanently destroy site productivity provided impacts are minimized and rate of impacts does not exceed rate of recovery over the long term. Soils in valley bottoms and other wet areas are highly sensitive to disturbance because proper functioning condition of wetland and riparian areas may be impacted if excessive ground disturbance occurs in these areas.

Specific soil properties, selected to assess FAA soil management interpretations, hydrologic function, ability to support plant growth, and sensitivity to/recovery from disturbance are described below.

**Depth of Surface Layer and Depth to Restrictive Layer**
Most uplands soils within the FAA are shallow (less than 15 inches to a restrictive feature). Project Design and mitigation measures to maintain adequate logging slash for erosion control and maintain nutrient cycling for long-term soil productivity are applicable to shallow soils in the FAA. Deeper soils are generally located in meadows and valley bottom/stream adjacent areas throughout the FAA. Existing roads and trails in these areas create ongoing soil, watershed and fisheries resource concerns. Heavy equipment operation for the Forsythe fuels reduction project is expected to be low in these areas.

**Soil Rock Content and Rock Outcrop**
Over 90% of upland soils within the FAA have greater than 35% rock fragments within the soil profile. Although this is typical of forest soils on the Boulder Ranger District, it is considered to be very high soil rock content. Generally, high soil rock content lowers the risk for deep compaction, lowers soil water holding capacity and lowers the volume of soil available for plant roots. Surface rock outcrop is dispersed throughout the project area, typically occurring along steep ridges or steep slopes adjacent to stream channels.

**Wet Soils, Riparian Areas**
Wet soils commonly occur in riparian areas adjacent to stream channels in valley bottoms throughout the FAA. For protection of riparian vegetation, soil and water quality, use of heavy equipment is excluded from these areas and mitigation measures to protect soil, water quality, vegetation and riparian resources are included in project design.

**Slopes, Roads and Trails and Erosion Potential**
Generally, undisturbed forested areas within the FAA are not highly susceptible to hill-slope erosion (stable) unless ground disturbance and removal of ground cover occurs. Roads and trails, throughout the area, ranged from relatively stable (healed over) to extremely unstable. Based on field observations, the road and trail network appears to be responsible for most of the soil erosion and sediment delivery to stream channels. Within the FAA, the actual density of roads and trails on the ground is greater than road density calculated from current transportation layers or the Boulder Ranger District Motor Vehicle Use Map. From a soil and watershed hydrologic function perspective, roads and trails that are not part of the designated transportation system are considered to be connected disturbed areas. Based on field observations, erosion and sediment delivery from these areas is currently impacting soil and water resources, particularly when exacerbated extensive off highway vehicle use.
High intensity thundershowers are the storms of highest concern for accelerating soil erosion and sediment delivery to streams. Snowmelt run-off is not likely to generate excessive erosion on treated hill-slopes. However, snowmelt run-off is likely to increase erosion of roads and trails throughout the project area.

Most of the FAA has gentle slopes of less than 30 percent. By project design, heavy equipment operations for proposed vegetation management activities are limited to slopes of less than 30 percent to lower the risk for excessive soil erosion following treatment. Large contiguous areas of slopes of greater than 30 percent are generally associated with the inner gorges of the south and middle forks of Boulder Creek, lower Forsythe Canyon and lower Winiger Gulch.

Throughout most of the FAA, hill-slope runoff potential is moderate. High runoff potential is common within steep valley inner gorges. Slope stability hazard (potential for mass wasting) is generally low with areas of moderate within the steep valley inner gorges. As expected, runoff potential and erosion/mass wasting hazard tends to increase with slope. Overall, the potential for wind erosion is low for the shallow, coarse textured soils within the FAA. However, potential for wind erosion does exist on ridgelines, particularly when exposed to the mountain peaks to the west.

Table 6 - Prescribed Fire Limitation Ratings
Region 2 Prescribed Fire Limitation Ratings are based primarily on slope, surface texture and effective rooting depth.

<table>
<thead>
<tr>
<th>Surface Texture</th>
<th>Slight</th>
<th>Moderate</th>
<th>Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slope</td>
<td>0-35%</td>
<td>35-55%</td>
<td>&gt;55%</td>
</tr>
<tr>
<td>Surface Texture</td>
<td>Medium</td>
<td>Clayey</td>
<td>Sandy</td>
</tr>
<tr>
<td>Depth</td>
<td>Deep</td>
<td>12-36 inches</td>
<td>Shallow</td>
</tr>
</tbody>
</table>

Table adapted from R2 Soil Interpretations

Within FAA proposed burn blocks, the predominant soil texture is sandy loam so soil texture is generally the least limiting factor for prescribed fire. Soils are typically less than 15 inches deep so depth is moderately to severely limiting for prescribed fire. Where severe limitation ratings occur, steep slopes are generally responsible. The most limiting factor determines the rating illustrated in the following map

Prescribed Fire Limitations
Generally, soils rated slight have few limitations that affect the re-establishment of vegetation and excessive erosion is not expected to result from the application of prescribed fire. Soils with moderate and severe limitations may require erosion control treatments following prescribed fire.

Condition of Soil Resources in Proposed Activity Areas
Field visits were conducted during the summer field season of 2011 to determine existing condition of soil resources in proposed activity areas. Ground cover, erosion (active or stabilized), residual compaction and displacement, depth of forest floor, surface layer, and general ground disturbance were monitored using the soil disturbance classification protocol. Data was collected by a combination of qualitative and quantitative methods. Transects, ocular observations, photographs and GPS points were collected.
Summary of Field Data Collection Efforts
Generally, ground cover was high (commonly above 90%) within proposed treatment areas and occurrences of active uplands erosion was low except for roads and other highly disturbed sites. This is because proposed treatment units are usually in areas where tree density is high, providing adequate needle-cast.

Detrimental compaction was generally limited to highly disturbed sites such as roads, trails, and other previously disturbed sites. Project area soils are not highly susceptible to deep compaction because they have sandy-loam textures and sub-soils are generally rocky.

Adequate amounts of large downed wood and slash, providing for nutrient cycling, were present in most areas. A range of decay classes of large downed wood was present but highly decomposed wood was not common. Since decomposition rates are slow and soils are not highly productive, it is important to retain fine slash and large downed logs for nutrient cycling. Following future bark beetle infestation and die-off, it is likely that more large woody material and fine slash will be recruited for decomposition and nutrient cycling.

Use and Disturbance History
Past ground disturbances from fire, mining, dam/reservoir construction, timber harvest, and off highway vehicle (OHV) use exist throughout the project area in various stages of degradation or recovery.

A 75-acre burned area (1952) is located within the FAA boundary and the Black Tiger burned area (1989) is located on the northern boundary of the analysis area. Many small fires (generally less than 1 acre) have occurred within and adjacent to the FAA. Past vegetation management activities within the FAA have also been completed and are detailed in the vegetation section of this document (Chapter 3, Page 90).

The project area also has an extensive road network. From a soil and watershed hydrologic function perspective, roads that are not part of the designated transportation system (unauthorized roads) are considered to be connected disturbed areas. Soil productivity and hydrologic function is generally detrimentally impacted where unauthorized roads occur or where excessive runoff causes erosion adjacent to the road prism. Overall, watershed hydrologic function is also adversely impacted by roads and other connected disturbed areas.

Desired Soil Resource Conditions
The desired condition for soils is to manage the soil resource such that the physical, chemical, and biological processes of the soil are maintained or enhanced (1997 Revised Forest Plan). Maintain long-term soil productivity by limiting detrimental soil impacts to less than 15% of any given activity area. This is achieved by application of relevant project specific Project Design, mitigation measures and watershed conservation practices (Watershed Conservation Practices Handbook, FSH 2509.25) to prevent or mitigate detrimental soil impacts.

Alternative A – No Action

Direct and Indirect Effects
**Direct Effects**
Mechanical, hand, or combination fuel reduction treatments would be not implemented. Project related ground disturbance and direct effects to soil resources would not occur and natural recovery of previously impacted areas would continue. Litter, slash, and large downed woody material would continue to accumulate and decompose at natural rates. Following mountain pine beetle infestation, accelerated accumulation of litter, slash, and large downed woody material would occur. This could alter nutrient cycling processes in the short and mid terms, particularly carbon and nitrogen cycling.

Proposed road actions and associated positive and negative effects would not occur. The existing road and OHV trail network would remain on the landscape. OHV activity would likely remain at current levels or increase, which would lead to additional erosion, compaction, and sedimentation.

**Indirect Effects**
Increased or reduced potential for adverse high severity wildfire effects as described in the indirect effects of fuels reduction treatments section of this report.

**Cumulative Effects**
Past measurable detrimental impacts to soils, associated with wild fires, timber harvest dispersed camping, roads and OHV use, and residential development, still exist on the landscape.

**Alternative B – Proposed Action**

**Direct and Indirect Effects**

**General Effects on Soil Resources**
- Erosion potential
- Compaction, displacement
- Ground disturbance
- Fire effects
- Nutrient cycling and export

The type, degree (severity) and spatial extent of potential impacts are strongly correlated with implementation methods used. Proposed fuels treatment activities, methods, acreages, and associated environmental impacts to soil resources are summarized in the following table. Definitions for the potential effect “numbers” are listed directly below the summary table.
Table 7 - Summary Table of Activities and Potential Effects on Soil Resources

<table>
<thead>
<tr>
<th>Treatment Description</th>
<th>Implementation Method</th>
<th>Units Affected</th>
<th>Acres</th>
<th>Potential Impacts*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lodgepole Pine Treatment</td>
<td>Combination of mechanical and manual with emphasis on higher effects from mechanical treatments</td>
<td>LP 1-25</td>
<td>2312</td>
<td>1,2,3,4,5,6,7,8</td>
</tr>
<tr>
<td>Ponderosa Pine Treatment</td>
<td>Combination of mechanical and manual</td>
<td>PP 1-22</td>
<td>1540</td>
<td>1,2,3,4,5,6,7,8</td>
</tr>
<tr>
<td>Meadow Enhancement</td>
<td>Manual</td>
<td>G 1-10</td>
<td>296</td>
<td>3,5,7</td>
</tr>
<tr>
<td>Quaking aspen Restoration</td>
<td>Combination of manual and mechanical with emphasis on minimal effects from manual treatments</td>
<td>A 1-11</td>
<td>209</td>
<td>3,5,7</td>
</tr>
<tr>
<td>Broadcast Burn</td>
<td>Prescribed Fire Methods</td>
<td>BB 1-6</td>
<td>968</td>
<td>9</td>
</tr>
</tbody>
</table>

| Total                      |                                                                                         |                |       | 5,325              |

Summary Description of Activities and Potential Effects on Soil Resources:
*Apply to Potential Effects Column in Table (above)

Effects of Mechanized Treatments (Heavy Equipment Operation)
1. Moderate to severe compaction, ground disturbance, removal of ground cover, and increased potential for erosion on designated skid-trails, landings, and temporary roads. These effects are considered to be short-term because they are mitigated through restoration activities such as de-compaction, lopping and scattering slash and seeding.
2. Discontinuous ground disturbance in unit (off designated skid trails) from heavy equipment operation results in removal of ground cover and disturbance of the surface layer of soil, particularly where multiples passes or turns are made. Low to moderate compaction and increased potential for erosion commonly occurs but these areas are generally small, isolated, and discontinuous. The degree and extent of impacts are highly dependent on treatment intensity and ground conditions during the implementation period. Natural recovery of these areas occurs through re-establishment of native, needle cast and natural accumulation of woody debris over time.

Potential Effects of Manual Treatment Activities
3. There are generally few effects to soil resources associated with low intensity manual fuel reduction treatments provided adequate amounts of fine slash, litter, and duff are retained within the activity area.

Potential Effects of Slash Disposal Activities
4. Machine pile burning and piling effects
5. Hand pile burn effects
6. Chipping and masticating effects, both positive and negative, are variable based on amount, depth, and spatial extent of coverage
7. Lop and scatter effects are generally positive but variable based on amount, depth and spatial extent of coverage
8. Removal of boles (trunks) from the activity areas
Potential Effects of Broadcast Burn Activities

9. Mosaic of low and moderate soil burn severity effects (described below) with emphasis on removal of ground cover in the form of litter, duff and ground cover vegetation. Increased erosion potential for 1-5 years following the fire.

Generally, mechanical vegetation removal activities and associated effects on soil resources are expected to be highest in the lodgepole pine treatment units. Thinning activities in the ponderosa pine treatment units are expected to be less intensive and have fewer effects on soil resources. In the aspen restoration treatment units, mechanical treatments will occur around the edges, but not within, quaking aspen stands. No mechanical treatments will occur within the Meadow Enhancement treatment units.

Mechanical Treatment Activities and Effects (heavy equipment operations)
As outlined in Table 7, above, heavy equipment operation will occur on all lodgepole and ponderosa pine treatment units, covering a total of 3,908 acres. Development of a network of designated skid-trails and landings is expected to occur in mechanically treated activity areas. Detrimental compaction, displacement, and removal of ground cover, and increased potential for erosion are expected to occur on skid-trails and landings where multiple passes with heavy equipment occur. Generally, a designated landing and primary skid-trail system is expected to cover between 12-25% of an activity area. These effects are considered to be short-term because they are mitigated through restoration activities such as de-compaction, lopping and scattering slash and seeding.

Potential Minor Effects within the Unit (Off Landings and Skid-trails)
Heavy equipment (skidder, feller-buncher, harvester, masticating and chipping equipment, etc.) operation off designated skid-trails is necessary to get to trees within the units. In clear-cut (sanitation and salvage treatments) and patch-cut units where tree density and/or treatment intensity is high (large proportion of trees removed), many passes and turns may cause minor ground disturbance over as much as 40-50% of the unit. Low to moderate compaction and increased potential for erosion commonly occurs but these areas are generally small, isolated, and discontinuous. The degree and extent of impacts are highly dependent on treatment intensity and ground conditions during the implementation period. Natural recovery of these areas occurs through re-establishment of native, needle cast and natural accumulation of woody debris over time.

Compaction and Displacement
Soils within the activity areas are not highly susceptible to deep compaction because they are coarse textured and have high rock content. However, compaction and displacement of the surface are expected to occur on temporary roads, skid-trails, landings where multiple passes with heavy equipment are made. Compaction does not always extend deep into the soil profile where soils are coarse textured and/or rocky. However, shallow compaction, increased runoff, and slower natural re-vegetation has been observed within similar activity areas. Compacted landings, temporary roads, and compacted portions of skid-trails would likely comprise less than 20% of the activity area. Compaction and/or displacement may occur in less traveled parts of the activity area if operations occur when soil is wet. Operating over a protective layer of packed snow and/or frozen ground may help prevent compaction but monitoring of similar projects
indicates that it is unlikely that snow cover or frozen ground would remain over the entire implementation period, particularly on south facing slopes. The upper reaches of Lump Gulch, Colorado Creek and Ellsworth Creek have deeper, finer textured soils that are inherently more susceptible to compaction than soils with coarser textures elsewhere in the analysis area.

Erosion may occur during snowmelt or any other runoff event but storms with greatest energy and potential to cause erosion are high intensity thundershowers. Erosion potential would increase during and following project implementation due to removal or disturbance of the litter/duff layer and/or vegetative ground cover.

Following disturbance, needle cast and re-vegetation with grasses, forbs and shrubs are natural recovery processes that would occur over time to stabilize disturbed hill-slopes. However, these processes take one or more growing seasons and strategies to prevent or minimize ground disturbance within treatment areas are preferred. Wet soil operating restrictions and use of designated skid-trails (with minimal passes and turns off skid-trails) would prevent excessive removal of ground cover during and following operations. Post treatment measures such as lopping/scattering of fine slash and water-barring skid trails would also decrease the risk of soil erosion.

**Nutrient Cycling**

In thinning units, the proposed activities have low potential to detrimentally impact long-term nutrient cycling processes because many trees would remain following treatment, providing material for recruitment of large downed wood, fine slash, or needle cast. Recruitment of material for decomposition is expected to occur naturally over time in these activity areas. The potential for nutrient cycling impacts in patch-cut or clear-cut areas is higher because more vegetative material is removed. However, provided retention of adequate amounts large downed wood and fine slash occurs (see Recommendations to Provide for Nutrient Cycling section in this report), effects to long-term nutrient cycling would be low.

The long term nutrient cycling in the proposed activity areas is dependent on a continual supply of slash and large downed wood for decomposition. Project area soils are relatively sensitive to ground disturbance and other impacts to nutrient cycling because a high proportion of their productive capacity is based on the nutrient rich surface layer. Decomposition of slash and large downed wood is relatively slow due to cold winter temperatures and limited moisture availability over much of the year. The “Effects of Lopping/Scattering, Chipping, Masticating” and “Effects of Pile Burning (Burn Effects on Soils)” sections of this report provide additional analysis on disturbance processes and nutrient cycling in LGAA soils.

**Ground Disturbance**

It is likely that passes and turns would be made off designated skid-trail systems, causing minor ground disturbance by mixing and churning of the soil, isolated and discontinuous areas of low to moderate compaction, removal of ground cover, and increased potential for erosion commonly. The exact spatial extent of these impacts depends on size of activity area, treatment intensity, topography, soil type, equipment used, ground conditions during implementation, operator skill, and other physical constraints such as rock outcrops.
Manual Treatment Activities and Effects
Manual treatments would be done by hand crews with chainsaws. Boles, limbs and slash would scattered or hand piled in the unit and burned at later date. With the exception of hand burn pile effects (discussed below), there would be minimal ground disturbance and adverse impacts to soil resources associated with these manual treatments. However, where ground cover or slash is sparse, it is important to scatter material to provide protective ground cover for erosion control and fine slash for nutrient cycling.

Broadcast and Pile Burning Activities and Effects
Under these conditions, the expected effect is a mosaic of low and moderate soil burn severity effects.

Broadcast Burn Effects
Soil burn severity is expected to be low over the grass dominated area and recovery of slope stability is likely to be rapid (1-2 years) provided adequate soil moisture is available to support re-growth of the grass. In the conifer stands of the south-western part of the burn block, ground cover is provided by pine needle litter, duff, grass/forbs and rock. Prescribed fire would likely char but not completely consume protective ground cover, resulting in a mosaic of low and moderate soil burn severity. Recovery of slope stability is likely to occur over 3-5 years through needle cast and establishment of grass and forbs. Prescribed fire in this forested, south-western part of the burn block has moderate to high potential to increase soil erosion and sediment delivery to Winger Gulch, particularly during the first thundershower season following the fire. This part of the burn block has a severe limitation rating for prescribed fire.

Ground Disturbance Effects of Using Heavy Equipment to Construct Burn Piles
In mechanically harvested units, burn piles would be located in the unit or on the landings. Operation of machinery to construct piles would likely cause ground disturbance, compaction, and removal or mixing of surface layer due to many passes and turns near piles. Machinery that lifts and places material into piles (such as a grapple piler) would minimize soil disturbance at pile locations. Machinery that pushes material into piles (such as a bulldozer or skidder with a blade) is likely to result in severe ground disturbance. Machinery that drags material into piles (such as skidder with a grapple hook) is likely to result in moderate ground disturbance.

Burn Pile Sizes and Spatial Extent (footprint) of Piles within Units
The exact spatial extent (cumulative footprint) of burn piles depends on the amount of material cut, amount of material disposed of by other methods, pile height, density and shape. This analysis considers the advantages and disadvantages of creating one large burn pile versus several smaller burn piles within treatment units. On a per acres basis, creating one large machine pile impacts less ground (area) than several short/small piles.

The larger piles are expected to generate more heat, burn longer and generate more severe burn effects than smaller piles. For the purposes of this analysis, it is expected that, regardless of pile size or soil type, burning machine piles with heavy fuels is most likely to create a high burn severity impact (see burn severity definitions in glossary) due to heat and residence time of the fire. Although burning hand piles is expected to result in lower burn severity and recovery times...
are expected to be faster, it is expected that the physical, chemical and biological fire effects, outlined below, would occur to the extent of the machine and hand burn pile sites.

Potential Effects of Broadcast and Pile Burning (Fire Effects on Soils)

Adverse fire effects on soils are proportional to the residence time of the fire and the amount of heat generated. Generally broadcast burning results in a mosaic of low and moderate soil burn severity effects. Due to longer residence time of fire, burning piles generally results in high to moderate soil burn severity effects.

Table 8 - Potential Effects of Broadcast and Pile Burning

<table>
<thead>
<tr>
<th>Physical Effects</th>
<th>Biological Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loss of litter layer, soil and soil organic matter</td>
<td>Direct mortality of soil organisms and loss of their habitat</td>
</tr>
<tr>
<td>Loss of soil structure</td>
<td>Fire may sterilize soils although natural recovery is expected to occur over time</td>
</tr>
<tr>
<td>Hydrophobicity (formation of water repellent layer)</td>
<td>Post fire changes in soil organism populations are invertebrate and fungi decrease and bacteria increase. These changes generally last a year or two.</td>
</tr>
<tr>
<td>In extreme cases, destruction of clay minerals</td>
<td></td>
</tr>
</tbody>
</table>

Chemical Effects

- Increase in pH
- Loss of cation exchange capacity
- Loss of nutrients by volatilization, in fly ash, or by leaching

Effects of Slash Treatment by Lopping/Scattering, Chipping and Masticating

In mechanically treated units, slash disposal and removal of material would be accomplished by one or more of the following methods: lopping and scattering, chipping, masticating, hand piling and burning, machine piling and burning, or skidding and removing. In manually treated units, slash disposal would be accomplished by lopping and scattering and/or hand piling and burning.

Effects of Chipping and Masticating Activities

The effects of these slash disposal activities on soil resources could be beneficial or harmful, depending on the amount, size, and spatial distribution of material retained.

Potential Positive and Negative Effects on Soil Processes/Functions are:

- Erosion Control - Retention of slash/chips/chunks may benefit soil resources by providing protective ground cover.
- Soil Nutrient status - Microbes decomposing this wood (chips and chunks) should immobilize nitrogen and reduce soil nutrient availability. When the wood becomes mostly decomposed, it should begin to release nitrogen and increase soil nutrient availability.
- Soil carbon - Little change in soil carbon because most of the carbon in the added wood will be lost through respiration
- Soil physical properties - Overstory thinning and the added wood will decrease evapo-transpiration due to fewer trees using the water and the physical barrier of the woody debris. The wood will also insulate the soil to reduce heat loss during the night/winter and reduce
heat load during the day/summer. The net result will be more moist soils with decreased diurnal and seasonal soil temperature fluctuations. However, the added wood could intercept and retain precipitation and cause lower soil moisture where small rain storms supply moisture. Additionally, heavy equipment used for chipping or mastication may compact the soil.

- Soil biota - Woody debris provides habitat for soil insects and microbes and addition of carbon from woody debris will lead to an increase in soil biota, especially fungal species that are the primary wood decomposers.
- Fire risk or behavior - Canopy fire risk will be reduced for some period of time, however material may smolder, resulting in a longer residence time and the heat pulse being directed down into the soil

Indirect Effects of Fuels Reduction Treatments

Reduced or Increased Potential for Adverse High Severity Wildfire Effects
The proposed treatments are strategically designed and located to reduce extreme wildfire behavior within treatment units. However, fire behavior and burn severity to soil resources are not directly correlated. In the event of wildfire, treated areas may experience lower burn severity effects within treated areas if consumption of ground cover and residence time of surface fuels is lower. However, if ground fuel loading is increased by slash disposal methods, ground fires could generate more heat, burn and smolder for longer periods of time, and generate more adverse effects on project area soils.

Detrimental effects to soil resources, particularly accelerated rates of erosion, are associated with high burn severity wildfire. The proposed treatments may indirectly lower or increase adverse wildfire effects, listed below, on FAA soil resources.

- Removal of large areas of protective ground cover, reduction of needle cast potential, and increase in erosion hazard
- Consumption of litter, duff, large downed woody material and volatilization of soil humus and associated plant available nutrients
- Formation of hydrophobic soil conditions
- Potential for increased mass wasting
- Other fire effects described in the pile burning section of this report

Direct and Indirect Effects of Proposed Road Actions

Road Related Effects on Soil and Watershed Resources

System Roads
Road use and improvement of current system roads would have variable effects on soil and watershed resources because the current use, condition, and stability of the road would determine the degree of the impact and whether the impacts would be negative or positive:

- Use and maintenance of roads for project implementation would generate additional short-term ground disturbance and sediment production
- Maintaining and using roads that are currently lightly used or unused, well vegetated, and stable would generate additional watershed impacts
- If the road is heavily used, poorly maintained, and unstable, maintenance actions may benefit watershed functions by reducing excessive erosion and/or mass wasting
- Obliteration/restoration of approximately 5.5 miles of current system roads that would be obliterated, if used, would benefit soil and water resources

Temporary Roads
Creating and using temporary roads would create additional soil displacement, compaction and erosion within the watershed. In this time period, it is likely that erosion from these road surfaces would occur in response to snowmelt and thundershower precipitation/runoff events. Obliteration/restoration of these areas would promote natural recovery by stabilizing erosion and re-establishing the hydrologic function of the soil in the disturbed area. Grasses and herbaceous vegetation would likely become established within one or two growing seasons while shrubs and conifers would take much longer. Implementation and effectiveness monitoring of the obliteration/restoration work is recommended to determine if closures, erosion control and re-vegetation efforts were effective and to determine if repair and/or maintenance of the treatments is needed.

Cumulative Effects
Past measurable detrimental impacts to soils, associated with wild fires, timber harvest dispersed camping, roads and OHV use, and residential development, still exist on the landscape. Potential direct effects associated with project implementation, as described in this report, are erosion, compaction, and impacts to nutrient cycling. Areas that were compacted or eroded are in various stages of recovery. Based on field reconnaissance, review of aerial photography and limited management activities within the past 30 years, the extent of past detrimental impacts is estimated to be low for project activity areas. Through prevention or mitigation, the sum of past (existing) impacts and project related direct effects would be kept within 15% of any given activity area (FSH 2509.18 and FSH 2509.25).

Air

Affected Environment
The Forsythe Fuels Reduction Project lies within the Front Range Airshed. This airshed includes the majority of the Roosevelt National Forest on the Boulder Ranger District. The area covered by this airshed is in elevations from 5,000 to 14,000 feet. The prevailing winds are generally east, west, and northeast, with a component of diurnal heating that can bring air back upslope in midday. This airshed has existing air quality impacts and the potential for more due to air pollutants such as sulfur dioxides, nitrogen oxides, ozone, and particulate matter (PM). There are five Air Quality Related Values (AQRVs) identified, within the Front Range Airshed, as having the potential to be impacted by human-caused air pollution. These five AQRVs are soil, water quality, flora, fauna, and visibility. Air pollutants come from many sources including prescribed fires, wildfires, oil and gas development, grazing, mining, developed recreation, and travelway use, both paved and non-paved.
Particulate matter (PM) is the term used for particles found in the air, including dust, dirt, soot, smoke, and liquid droplets. Particles can be suspended in the air for long periods of time. Some particles are large or dark enough to be seen as soot or smoke. Others are so small that individually they can only be detected with an electron microscope.

Particulate matter is classified by size of the particles into two categories, PM10 and PM 2.5. PM10, particles less than 10 microns in diameter, pose a health concern because they can be inhaled into and accumulate in the respiratory system. PM2.5, particles less than 2.5 microns in diameter, is referred to as “fine” particles and is believed to pose the greatest health risks. Because of their small size, approximately 1/30th the average width of a human hair, fine particles can lodge deeply into the lungs. Individuals that may be particularly sensitive to fine particle exposure include people with heart or lung disease, older adults, and children.

The Colorado Air Pollution Control Division records pollution data by county rather than by airshed. The latest available recorded data for Boulder and Gilpin Counties is 2007. Particulate Matter is recorded because it is of primary concern to the Environmental Protection Agency and proposed project activities are likely to increase only particulates. However, PM2.5 data is not recorded for Boulder or Gilpin Counties only the PM10 data (Table 9). Boulder County’s primary source of particulate pollutants is construction and Gilpin County’s is road dust.

Table 9 - PM10 Emissions for Boulder and Gilpin Counties by Source for 2007.

<table>
<thead>
<tr>
<th>Source</th>
<th>Boulder County</th>
<th></th>
<th>Gilpin County</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PM10 (tons per year)</td>
<td>PM10 (% of total)</td>
<td>PM10 (tons per year)</td>
<td>PM10 (% of total)</td>
</tr>
<tr>
<td>Agriculture</td>
<td>435</td>
<td>8.79</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Aircraft</td>
<td>8</td>
<td>0.16</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Biogenic</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Commercial Cooking</td>
<td>131</td>
<td>2.65</td>
<td>4</td>
<td>0.76</td>
</tr>
<tr>
<td>Construction</td>
<td>2,285</td>
<td>46.17</td>
<td>140</td>
<td>26.77</td>
</tr>
<tr>
<td>Fuel Combustion</td>
<td>2</td>
<td>0.04</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Highway Vehicles</td>
<td>84</td>
<td>1.70</td>
<td>3</td>
<td>0.57</td>
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<tr>
<td>Non-Road</td>
<td>153</td>
<td>3.10</td>
<td>11</td>
<td>2.10</td>
</tr>
<tr>
<td>O&amp;G area</td>
<td>4</td>
<td>0.08</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Railroads</td>
<td>9</td>
<td>0.18</td>
<td>5</td>
<td>0.96</td>
</tr>
<tr>
<td>Road Dust</td>
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<td>18.02</td>
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<td>56.60</td>
</tr>
<tr>
<td>Stationary Sources</td>
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<td>14.10</td>
<td>9</td>
<td>1.72</td>
</tr>
<tr>
<td>Structure Fires</td>
<td>3</td>
<td>0.06</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Wood burning</td>
<td>245</td>
<td>4.95</td>
<td>55</td>
<td>10.52</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>4,949</strong></td>
<td><strong>100</strong></td>
<td><strong>523</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

The National Ambient Air Quality Standards (NAAQS), in any 24-hour period, for PM2.5 is 35 micrograms per cubic meter (µg/m³) and PM10 is 150 µg/m³. The visibility standard range, under the Ambient Air Quality Standards for the State of Colorado, is 32 miles. These two parameters are used by the Air Pollution Control Division (APCD) to determine the permitting of prescribed fires in the state. If these parameters are exceeded, the APCD would not grant...
permission to prescribe burn on a given day. Planned Forest Service broadcast burning projects in Boulder and Gilpin Counties over the next five years may contribute up to an estimated 121.6 tons of PM10 (Table 9). However, on average the Forest Service may add up to an estimated 24.3 tons of PM10 in any given year, or about 0.49% of Boulder County’s annual total and 4.65% of Gilpin’s.

Table 10 - Total PM Budget Boulder Ranger District Prescribed Burning within Front Range Airshed.

<table>
<thead>
<tr>
<th>Project Proposal</th>
<th>PM10$^{(2)}$ Max. tons per year$^{(3)}$</th>
<th>PM2.5 Max. tons per year</th>
</tr>
</thead>
<tbody>
<tr>
<td>James Creek</td>
<td>90.9</td>
<td>76.9</td>
</tr>
<tr>
<td>Sugarloaf</td>
<td>30.7</td>
<td>26.0</td>
</tr>
<tr>
<td>TOTAL Maximum</td>
<td>121.6 tons</td>
<td>102.9 tons</td>
</tr>
</tbody>
</table>

Notes:
1. These numbers are rough guesses biased toward showing the maximum emissions possible in one year.
2. The total maximum tons, shows how much emissions would be produced if all acres across all the projects were burned in one year. However, it is virtually impossible to burn all the above projects in any one year. Actual emissions would depend heavily on the number of acres burned for each project per year.
3. Given uncertainty about timing of burns, this estimate should be used for any one year between 2012 and 2017.

The APCD no longer requires the Forest Service to run smoke models for any prescribed burn projects, including pile burns. For any proposed prescribed burn project, the Forest Service is required to give APCD some general information regarding the burn including the location of the burn, proposed burn date(s), distance (in miles) to the closest occupied residence, smoke sensitive receptors (including nearest community, subdivision, and Class I airsheds within 25 miles of the proposed burn), and minimum elevation of the burn. Additional information is needed for broadcast burns including brief description of the fuels, smoke fuel category (meaning the potential to create smoke impacts), dominant National Fire Danger Rating System (NFDRS) fuel model, ignition method (hand vs. aerial), site fuel load, and method used to estimate the fuel loading. For pile burning, the following additional information is needed, 1000-hr. fuels as a percent of the volume, brief description of the fuels, average cubic foot volume of the piles, pile dimensions, and construction method. The number of piles allowed to be burned depends on the average size of the piles and distance from an occupied residence. Broadcast burning acreage allowed depends on the smoke fuel category and distance to an occupied residence.

Attainment / Maintenance Areas
The Front Range Airshed is, for the most part, within an attainment or maintenance area. Boulder County is in non-attainment for 8-hour ozone. Attainment and maintenance refers to the National Ambient Air Quality Standards. Nonattainment is any area that does not meet (or that contributes to ambient air quality in a nearby area that does not meet) the national primary or secondary ambient air quality standard for the pollutant. Attainment refers to any area (other than an area identified) that meets the national primary or secondary ambient air quality standard for the...
pollutant. Maintenance describes an area that was in nonattainment for any air pollutant for an area but has since attained the national primary ambient air quality standard for that air pollutant.

**Smoke Receivers / Concerns**

Smoke receptors are located in the cities of Boulder, Louisville, Superior, Broomfield, Arvada, Golden, Wheat Ridge, Lakewood and Nederland; Rocky Mountain National Park, Mount Evans Wilderness, Vasquez Wilderness and Indian Peaks Wilderness (Class I Airsheds); State Highways 72, 93, 119 and US Highway 36; hospitals within 25 miles of the burn, and all other homes associated and not associated with a subdivision are considered areas that may be smoke receptors or have smoke concerns for the project area.

**Desired Condition**

The desired condition within the Front Range Airshed is to maintain, and where appropriate decrease, the impacts to the Air Quality Related Values (AQRVs) to levels at or below the National Ambient Air Quality Standards (NAAQS). The overall desired condition is to maintain, and where appropriate decrease, Forest emissions budgets to levels at or below those accepted by the State.

**Alternative A**

**Direct and Indirect Effects**

The direct and indirect effects of the no action alternative on the air resource are that there would be no increased effects on air because this alternative is a no action alternative. There would still be dust created from the existing roads in the area, in turn, affecting the pollution in the air.

**Cumulative Effects**

There will continue to be vehicles traveling along the paved and unpaved roadways which will continue to contribute to the particulate matter for the Front Range Airshed.

**Alternative B**

**Direct and Indirect Effects**

The direct and indirect effects of the proposed action on air are an increase in particulate matter dust due to the operations that will be performed within the units. The Colorado Air Pollution Control Division (APCD) limits the size of the piles that can be burned at any one time. The APCD generated the emission production for different sized piles ranging from less than 300 ft$^3$ to 10,000 ft$^3$. More piles can be burned if they are smaller in size. The larger the piles get, the more restrictive the APCD is regarding number of piles burned in a day. These regulations will not allow us to exceed the air quality standards for piles.

As with pile burning, the APCD also regulates the number of acres of broadcast burning allowed in any given day as per the Smoke Impact Spreadsheet (SIS) model. The guidelines set forth by
the APCD would keep the Forest Service from exceeding the air quality standards for broadcast burning.

**Cumulative Effects**

Cumulatively, particulate matter will be produced, increasing the effect on the Front Range Airshed. Activities that will produce particulate matter include road dust, smoke from broadcast burning, and smoke from pile burning. This increase in particulate matter will not exceed the NAAQS, however.

**Fire and Fuels**

**Affected Environment**

**Characteristic Fire Regime**
Fuel hazard is defined by the percent canopy cover, tree/shrub/forb/grass species, and the presence of ladder fuels (Table 11). There are approximately 1,295 acres within the project area that are classified as a low fuel hazard. Low fuel hazard means that the percent of canopy closure is 0 – 10% and the absence of ladder fuels. Moderate fuel hazard covers approximately 2,779 acres of the project area and is defined by having a canopy closure of 11 – 39% with some ladder fuels. There are approximately 3,189 acres of high fuel hazard, defined as 40 - 69% canopy closure and more ladder fuels than in moderate fuel hazard. There are approximately 1,980 acres of very high fuel hazard, defined as 70+% canopy closure and ladder fuels throughout the entire stand. In general, lodgepole pine stands have a high canopy closure percentage but a low percentage of ladder fuels and therefore do not have a very high fuel hazard.

**Table 11 - Acres of fuel hazard on Forest Service lands by class and cover type for the project area.**

<table>
<thead>
<tr>
<th></th>
<th>Low</th>
<th>Moderate</th>
<th>High</th>
<th>Very High</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quaking aspen</td>
<td>392</td>
<td></td>
<td></td>
<td></td>
<td>392</td>
</tr>
<tr>
<td>Douglas-fir</td>
<td></td>
<td>339</td>
<td>552</td>
<td></td>
<td>891</td>
</tr>
<tr>
<td>Limber</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>Lodgepole</td>
<td>305</td>
<td>27</td>
<td>2852</td>
<td></td>
<td>3184</td>
</tr>
<tr>
<td>Pinyon/Juniper</td>
<td></td>
<td></td>
<td>333</td>
<td></td>
<td>333</td>
</tr>
<tr>
<td>Ponderosa</td>
<td>1305</td>
<td></td>
<td>1428</td>
<td></td>
<td>2733</td>
</tr>
<tr>
<td>Spruce/fir</td>
<td></td>
<td></td>
<td>4</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Rock/Water</td>
<td>207</td>
<td></td>
<td></td>
<td></td>
<td>207</td>
</tr>
<tr>
<td>Forb</td>
<td>384</td>
<td></td>
<td></td>
<td></td>
<td>384</td>
</tr>
<tr>
<td>Willow</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Grass</td>
<td>482</td>
<td></td>
<td></td>
<td></td>
<td>482</td>
</tr>
<tr>
<td>Shrub</td>
<td>626</td>
<td></td>
<td></td>
<td></td>
<td>626</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>1295</td>
<td>2779</td>
<td>3189</td>
<td>1980</td>
<td>9243</td>
</tr>
</tbody>
</table>

**Urban Interface Issues**

The communities of Nederland, Boulder, Wondervu, Pinecliffe, Lincoln Hills, Pactolus; the subdivisions of Tungsten, Walker Ranch, Big Springs, Sugarloaf and several other properties not
associated with subdivisions are within or adjacent to the project area. Gross Reservoir is one of Denver’s water sources.

**Fire History**

When characterizing wildland fire behavior it is useful to describe fire behavior that occurs during three weather situations: 1) "typical" - high fuel moistures, 2) "intense" - large fuels less than 13% fuel moisture, and 3) "extreme" - both low fuel moistures and high winds. Typically, regardless of the vegetation in which an ignition occurs, under average weather a fire can readily be suppressed. Under an extreme situation, all stands are susceptible to fire spread. “Extreme weather conditions can create fire behavior that can burn through or breach most fuel treatments (Finney and others 2003 and Graham, et al 2004).” Rare but large and consequential fires under intense conditions, 90th percentile weather (meaning that if you have a 100 day fire season, 10 days out of that 100 day period have the potential for high fire behavior if an ignition were to occur. Reversely, 90 days out of those 100 will have the potential for a lower fire behavior given an ignition on one of those days. Ninetieth percentile weather is measured in many different ways (i.e. Energy Release Component, Burning Index, 1000-hour fuel moistures, etc.) and are a focus of the proposed action and this analysis.

Because wind comes generally from the east, north, and northeast, ignitions that occur in a stand with ladder fuels and downed woody debris during intense or extreme fire weather are most apt to threaten the private property surrounding the project area. During a wind event, only a large break in the canopy will inhibit fire spread through the crowns. However, fire will continue to spread through the surface fuels. In the past, periodic landscape wildfires spread for many miles when weather remained dry and windy in summers with little rain. With strong winds, topography normally has little influence on fire spread. With current suppression capabilities, major crown fires on the Arapaho/Roosevelt most often cover two to three miles. The largest recorded on the forest, Bobcat, spread for ten miles.

Fire history in the Caribou, Thorodin, Sugarloaf, and Lump Gulch Geographic Areas shows 244 fires, but only five wildfires over 10 acres in size (Table 12). There have only been two wildfires within the project boundary over 10 acres in size and are denoted by "*" in the table. The Comforter fire in 1976 is the largest wildfire within the project boundary. There have been 112 fires within the project boundary for a total acreage burned of 327.4 acres. All five of the large fires were human caused. The Black Tiger fire scar is still identifiable on the landscape.

**Table 12 - Wildfires over 10 acres in size within Caribou, Thorodin, Sugarloaf, and Lump Gulch Geographic Areas.**

<table>
<thead>
<tr>
<th>Fire Name</th>
<th>Date</th>
<th>Acres Burned</th>
</tr>
</thead>
<tbody>
<tr>
<td>*Winiger Point</td>
<td>9/4/1978</td>
<td>19</td>
</tr>
<tr>
<td>Pactolus</td>
<td>3/29/1968</td>
<td>27</td>
</tr>
<tr>
<td>Tall Timbers</td>
<td>9/3/1984</td>
<td>51</td>
</tr>
<tr>
<td>*Comforter</td>
<td>6/11/1976</td>
<td>256</td>
</tr>
<tr>
<td>Black Tiger</td>
<td>7/9/1989</td>
<td>1,804.6</td>
</tr>
</tbody>
</table>

(*Occurred within project boundary.)
Since 1951, about 90% of the fires that occurred within the above mentioned geographic areas have been 1 acre or less in size. This is due to in part because of active fire suppression tactics to help minimize resource damage and prevent loss of private property. Most fires have occurred in June, July, August, and September within the geographic areas represented. July, with 58 fires recorded, has been the most active fire month since fire history has been tracked for the area. Human caused fires account for about 66% of the total number of fires that have occurred within the above mentioned geographic areas, with 63% occurring between June and September.

**Wildland Fire Management Strategy**

The wildland fire management strategy for the Caribou Geographic Area is as follows: management area 1.2 is prescription control and management areas 3.5, 4.3, and 7.1 are either perimeter or direct control depending on location of the wildfire. Both Thorodin and Sugarloaf Geographic Areas are direct control. The Lump Gulch Geographic Area is both perimeter control and direct control depending on location of the wildfire. Perimeter control is a strategy that seeks to confine the active zone that is responsible for fire spread. Actual fireline location will be selected to minimize the combined cost of suppression and the values that could be lost in a fire. The benefits of the fire’s effects may also be used to determine location. Direct control is the immediate and complete extinguishments of a wildfire. This includes exposure protection in which critical resources such as houses are shielded from a fire. Prescription control is when a fire is considered to be controlled as long as it burns within specific geographic boundaries and predetermined burning properties. These parameters are contained within a written prescription. The prescription allows those fires to continue to burn that are seen as advancing management goals.

**Values at Risk**

Values at risk from a wildfire include the communities of Nederland, Boulder, Wondervu, Pinecliffe, Lincoln Hills, Pactolus; the subdivisions of Tungsten, Big Springs, Walker Ranch, and Sugarloaf; and several other properties not associated with subdivisions within and adjacent to the project area, Denver’s water source (Gross Reservoir), other water resources (Barker Reservoir), Twin Sisters radio repeater, timber resources, and threatened and endangered species habitat.

**Desired Condition**

Creating 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 is the desired condition for the Caribou, Thorodin, Sugarloaf, and Lump Gulch Geographic Areas. Reducing the surface fuel loading and increasing the spacing between tree crowns, or decreasing the canopy closure from 70% or greater to a more manageable 10 to 69%, will modify fire behavior within the project area. By decreasing the canopy closure, the fuel hazard moves from high and very high to low and moderate, in those areas across the landscape where treatment occurs.

Percentile weather is often used to help gauge what prescriptions or alterations to the landscape may be needed to help reduce fire behavior in critical areas. Percentile levels give an indication of the current situation compared to previous years in the weather database. 90th percentile weather conditions are good parameters to use for modeling fire behavior. 90th percentile weather can be described by having only 10 percent of the days in the historical database with an
The desired condition would allow for a wildfire to burn under 90th percentile weather with less severe fire behavior due to treatments across the landscape.

**Alternative A – No Action**

**Direct and Indirect Effects**

Currently the project area has pockets of mountain pine beetle infestations within the lodgepole pine stands. The ponderosa pine stands also have beetle infestations but much less than the lodgepole stands. These stands are surrounded by meadows, quaking aspen stands, and mixed conifer stands. It is expected that the mountain pine beetle infestation will continue to kill more and more lodgepole pine within and adjacent to the project area. The fuel models used to describe the existing vegetative conditions were derived from the “Standard Fire Behavior Fuel Models: A Comprehensive Set for Use with Rothermel’s Surface Fire Spread Model” also known as the new set of 40 fuel models (Scott and Burgan, 2005). The GS fuel models describe conditions with Grass-Shrub, GR fuel models describe conditions associated with Grass, and TL fuel models describe conditions with Timber Litter.

The stands within the project area are best represented by fuel models GS1 (Low Load, Dry Climate Grass-Shrub – models the southern aspects with a grass-shrub mix including some of the ponderosa pine stands), GR2 (Low Load, Dry Climate Grass – models some of the meadow areas as well as some of the quaking aspen stands), TL1 (Low Load Compact Conifer Litter – models the pure lodgepole stands), TL2 (Low Load Broadleaf Litter – models the pure quaking aspen stands), TL3 (Moderate Load Conifer Litter – models the mixed conifer stands that have more downed woody material), and TL8 (Long-Needle Litter – models pure ponderosa pine and mixed conifer stands with mostly needle cast but also has small non-continuous areas of grass and shrub in the understory). To best model the potential fire behavior in some of the existing stands, a combination of fuel models were used. The more open ponderosa pine stands are best represented by TL8 in the overstory and GS1 in the understory; the more open quaking aspen stands are best represented by TL2 in the overstory and GR2 in the understory; the more open lodgepole pine stands are best represented by TL1 in the overstory and GR2 in the understory; and the mixed conifer stands are best represented by TL3 in the overstory and GS1 in the understory. The pure lodgepole pine stands generally do not have a significant understory component so those are best represented by just the TL1 fuel model, the pure quaking aspen stands can be best represented by using the TL2 fuel model only, and the pure ponderosa pine stands are best represented by only a TL8 fuel model.

Using Fire Family Plus, 90th percentile weather conditions were developed using the Sugarloaf Remote Automated Weather Station (RAWS) readings archived since 1977. The 90th percentile weather indices are as follows: 1-hr fuel moisture – 3%, 10-hr fuel moisture – 4%, 100-hr fuel moisture – 7%, 1000-hr fuel moisture – 10%, live herbaceous fuel moisture – 11%, live woody fuel moisture – 59%, 20-ft wind speed – 12 mph, mid-flame wind speed – 3.6 or 4.8 mph (using a 0.3 or 0.4 wind reduction factor respectively), relative humidity – 15%, and air temperature – 89 °F. The wind adjustment factor captures the effect the canopy and slope have on sheltering the fuels from the wind. The wind adjustment factor is a value between 0 and 1 and is used to calculate the mid-flame or eye level winds from the 20-ft winds. Areas with less or no tree cover
are referred to as unsheltered fuels where the windspeed of the mid-flame winds are higher because there are no trees to keep from exposing those fuels to the winds.

Canopy bulk density is the main driver, along with slope, in determining the type of fire that will occur. Canopy bulk density is defined as the oven dry weight of the available canopy fuel per unit of canopy volume, including the spaces between the tree crowns. Available canopy fuel is the part of the canopy that can burn in the flaming front of a crown fire. The foliage and some branch wood, which is less than 0.25 inches in diameter, are considered available canopy fuel. Canopy bulk density is expressed in kilograms per cubic meter and can range from zero, where there is no canopy, to about 0.0312 lb/ft$^3$ (0.5 kg/m$^3$), in very dense stands.

The estimated canopy bulk densities used for modeling the existing conditions were: ponderosa pine stands, 0.0104 lb/ft$^3$ (0.166 kg/m$^3$), (using the Ponderosa Pine Initial Condition); for the pure lodgepole pine stands, 0.0070 lb/ft$^3$ (0.112 kg/m$^3$), (using the Lodgepole Pine Initial Condition); and for the mixed conifer stands, 0.0056 lb/ft$^3$ (0.089 kg/m$^3$) (using the Ponderosa pine/Douglas-fir Initial condition). These canopy bulk densities were based on a study (“Stereo Photo Guide for Estimating Canopy Fuel Characteristics in Conifer Forests”) done by Joe Scott and Elizabeth Reinhardt in ponderosa pine, Douglas-fir, lodgepole pine, and mixed conifer stands in Arizona, Montana, Idaho, and California (Scott and Reinhardt, March 2005).

Two different fire behavior models were used for this analysis, BehavePlus 5.0.5 and NEXUS 2.0. BehavePlus 5.0.5 was used to calculate surface fire behavior for the TL2, TL2/GR2, GR2, and GS1 fuel models. BehavePlus 5.0.5 predicts the type of fire, rate of spread, flame length, acres burned after 1 hour, scorch height, and mortality. NEXUS 2.0 was used to predict crown fire potential for the TL1, TL1/GR2, TL3/GS1, TL8, and TL8/GS1 stands within the project area. NEXUS 2.0 predicts the type of fire, rate of spread, flame length, torching index, and crowning index.

The inputs needed for BehavePlus 5.0.5 include: first fuel model, second fuel model, first fuel model coverage, canopy height, canopy base height, canopy bulk density, mortality tree species, diameter (2”-12”, in increments of 2”), were used to simulate existing diameters), 1-hr fuel moisture, 10-hr fuel moisture, 100-hr fuel moisture, live herbaceous moisture (a value of 30% was used as that is the lowest value allowed in the model), live woody moisture, foliar moisture, 20-foot wind speed, wind adjustment factor, air temperature, slope steepness, and elapsed time.

The inputs needed for NEXUS 2.0 are as follows: simulation type (conifer and shrub were used), fuel model (overstory and understory), wind reduction factor, 1-hr fuel moisture, 10-hr fuel moisture, 100-hr fuel moisture, live herbaceous moisture content (a value of 30% was used as that is the lowest value allowed in the model), live woody moisture content, canopy bulk density, canopy base height, canopy fuel load, foliar moisture content (a value of 70% was used as that is the lowest value allowed in the model), shrub transition flame length, 20-foot wind speed, slope, and wind direction. Instead of using wind directions from all vectors observed from the Sugarloaf RAWS, a value of ‘0’ was used to simulate upslope winds which would predict the worst case scenario.
The slope percentage used in both fire behavior models was 30%. Thirty percent is an average of the slopes existing within the project area. The slope percentage and crown base height play a vital role in the type of fire seen. The greater the slope, the less space between the surface fuel bed and the canopy of the trees, therefore creating the potential for an active crown fire. Similarly, the lower the crown base height, the greater the potential for an active crown fire.

Based on average time of initial attack ground crews to arrive on scene of a wildfire, an elapsed time of one hour was used to predict the potential acres burned in that time frame. In stands affected by the mountain pine beetle, I used a formula developed by Dr. Matt Jolly to adjust the canopy base height to compensate for lower fuel moisture contents as exhibited in red needle trees (USDA Forest Service, Northern Region, Fire, Air & Aviation, September 2011). The lowest foliar moisture content allowed by the models is either 30% (BehavePlus 5.0.5) or 70% (NEXUS 2.0) which does not accurately represent the lack of moisture in the needles.

The types of fire that may be represented are surface, passive, conditional, and active crown fires. Surface fires are defined as fires that do not get into the canopy, but stay on the ground only. Passive crown fires, also called torching fires, are defined as when individual or small groups of trees torch out, but solid flame is not consistently maintained in the canopy. Conditional crown fires are defined as a potential type of fire in which conditions for sustained active crown fire spread are met but conditions for crown fire initiation are not. In other words, if a fire begins as a surface fire, then it is expected to remain so. If a crown fire has already initiated, for example in an adjacent stand, then it may continue to spread as an active crown fire through those modeled stands.

Active crown fires, also called a running or continuous crown fire, are defined as when the entire surface/canopy fuel complex becomes involved, but the crowning phase remains dependent on heat from the surface fuels for continued spread. They can be characterized by a solid wall of flame extending from the fuel bed surface through the top of the canopy.

Torching index is defined as the open windspeed at which crown fire activity can initiate for the specified fire environment (surface and canopy fuel characteristics – i.e. fuel model, windspeed and direction, relative humidity, and slope steepness). Crowning index is defined as the open windspeed at which active crown fire is possible for the specified fire environment (surface and canopy fuel characteristics – i.e. fuel model, windspeed and direction, relative humidity, and slope steepness). In other words, at windspeeds less than the torching index a surface fire is expected. If the windspeed is greater than the torching index but less than the crowning index a passive crown fire (torching) is expected. When windspeeds are greater than the crowning index an active crown fire can be expected.

Because wind is the main driver of large fires on the Forest, wind gusts were used to predict potential fire behavior within the project area on typical high wind days. The Colorado Wildfire Risk Assessment system was used to get the most likely maximum possible wind gust for the project area. Fire weather meteorologists developed nine Weather Influence Zones (WIZ’s) based on data from RAWS stations within each zone. Only one RAWS was selected to best represent average WIZ conditions in each zone. WIZ 3 represents the project area which is made up of several different counties including Boulder and Gilpin Counties. Coral Creek RAWS was
used as the representative station within WIZ 3. Under 90th percentile weather conditions, the most likely maximum possible 20 foot wind gust for WIZ 3 would be 29 miles per hour.

In the absence of natural or human caused fire across the landscape, except in recently burned areas, there is an increased amount of dead and down woody debris along with ladder fuels. Prior to the time when suppression became the goal of the Forest Service for all fires, the vegetation represented across the project area would have typically burned with low intensity in the surface fuels with occasional torching. These fires helped keep the amount of dead and down woody debris and ladder fuels in a state that would keep fire on the ground and out of the crowns. The lodgepole pine stands are an exception to this as they usually require stand replacement fires to regenerate. However, these stand replacement fires occur infrequently, usually every 100 years or more. Due to the success of fire suppression over the last 50+ years, there is little separation between the crowns of the trees due to overcrowding and presence of ladder fuels across the project area. To add to the overcrowding, in the lodgepole pine stands, there is currently a mountain pine beetle infestation which increases the potential for high intensity and high severity wildfires.

Most pure lodgepole pine stands tend to have tight, dense canopies with little sunlight and moisture getting through to the understory. Because of the lack of sunlight and moisture, not much grows there. There may be a few shrubs here and there but the majority of the understory is made up of compact needle cast. Fires in needle cast tend to burn slowly and can be described as low intensity, low flame length, creeping ground fires. These stands may also have an occasional heavy accumulation of dead and down woody material, referred to as a jackpot of fuel, in the understory. When fire encounters these jackpots, more heat is produced, preheating the needles in the canopy, allowing for the fire to more easily go from the ground to the crown. Without enough wind to sustain a crown fire, typically only torching of a few trees would be observed where jackpots are present.

The existing pure lodgepole pine stands (TL1), not currently infested with the mountain pine beetle, would exhibit minimal surface fire behavior in the event of a wildfire under 90th percentile weather conditions. However, these stands are also susceptible to conditional crown fires when the windspeeds increase to about 18 miles per hour (mph). As long as the fire in an adjacent stand is a crown fire and the windspeeds are conductive to keeping the fire in the crowns, the fire would continue as a crown fire into the pure lodgepole pine stands. Once the windspeeds decrease or there is a large break in the canopy, the fire would again come back down to the surface and burn slowly through the understory. For the most part, fires within the unaffected pure lodgepole pine stands would allow ground crews to easily suppress fires.

Not all lodgepole pine stands are densely populated with tight canopies. Depending on where the stands are growing in relation to aspect and elevation, some are more open with small amounts of grass in the understory (TL1/GR2). Fire in these stands would be more intense because of the grass component. Grass is considered a fine flashy fuel because it readily ignites and consumes rapidly especially when dry. The grass component would allow fire to advance faster than it would in the needle cast under the closed canopy lodgepole pine stands. Passive fire could be expected due to the available understory fuels preheating the needles in the trees. With winds of about 13 mph, these stands could become active crown fires.
There are several pockets of lodgepole pine trees that have been altered by the mountain pine beetle. The mountain pine beetle affects the trees by lowering the foliar moisture content in the needles of the tree. In healthy lodgepole stands, a jackpot of fuel is needed to preheat and dry out the needles enough before torching can take place. In beetle hit stands, the needles are already dry and do not need the jackpot of fuels to preheat the needles before torching can occur.

The beetle infestation could lead to extremely volatile fuels within the project area once the needles begin to turn from green to shades of red. The lack of moisture within the needles would allow for a fire to become a crown fire with very little wind and much lower temperatures. These stands can be described as 50 foot grass stands and would be modeled as such. With grass fuel models, temperature and humidity play a major role in what the fire will do.

It has been observed in Vanderhoof, British Columbia, Canada that there are different stages of coloring seen in the needles and boles following a beetle attack. The needles go from green to yellow/orange to red to purple and then the trees seem to look black from an aerial view and then turn grey.

Typically the needles will begin to turn yellow/orange within a year of the tree being attacked. This stage is the most volatile stage because the needles still have similar chemical properties of green needles with much lower foliar moisture contents. Fire can be described as either a surface fire or crown fire with no torching observed and no warning of when the fire transitions into a running crown fire. There does not need to be a ground fire for spotting to occur. It can occur from crown to crown where an ember lands in the canopy and ignites immediately.

When the needles turn red, again the fire behavior exhibited can be described as either a surface fire or a crown fire with no transition between. The needles then turn purple at which stage torching is exhibited. Fires in this stage are less severe.

The black stage is when the needles have fallen off the trees but the branches are still attached to the bole of the tree. Crown fire cannot be sustained within these trees unless 30% or more of the trees surrounding the black trees have green needles. Crown fire can be initiated at that point and sustained until there is no more continuous fuel. There can be individual or group torching occurring in these stands.

The grey stage is described as when the branches have fallen off the tree and all that is left is the bole of the tree. Vanderhoof has not experienced fire within this stage yet. However, research shows that the fire risk would go down until the boles begin to fall down. During the period in which the trees lose their needles and the trees fall down, a sub forest will have begun. Regeneration in beetle killed sites would be ladder fuels or an extension of ground fuels. Once the stems fall down, a large increase in down woody fuel coupled with the regeneration would be cause for a very intense fire.

Passive fire in these beetle infested stands (TL1 and TL1/GR2) could be expected under 90th percentile weather conditions. Once fire is in the crowns, windspeeds of about 13 mph would be required to sustain a crown fire run. Fires in these stands would pose a serious risk to the
surrounding houses and infrastructure and dangerous for any ground suppression resources because of the high intensity and high flame lengths.

The quaking aspen stands (TL2 and TL2/GR2) within the project area have different characteristics depending on their location on the landscape. Some of the stands have only leaf litter in the understory, where other stands have a mix of forbs and leaf litter. Fires within these fuel types, for the most part, are slower burning and have a low intensity under 90th percentile weather conditions. Most quaking aspen stands are moist and therefore the leaf litter retains more moisture keeping the fire from burning through the stand rapidly. This is especially true in the spring and early summer. As the air gets hotter and dries, the litter begins to dry out allowing for fire to move faster in these stands. Ground suppression resources would have little difficulty suppressing fire within these stands.

Fire behavior on some of the southern aspects and the meadows (GS1 and GR2) would be intense due to the fine flashy fuel, such as grass and shrubs, which readily burn under 90th percentile weather. Higher flame lengths and very fast rates of spread would be expected. These fuels would be somewhat harder for ground crews to use direct suppression tactics to control a wildfire, rather they may use more of an indirect strategy instead. The difference in tactics equates to a potentially larger area burned by a wildfire unless other types of firefighting resources, such as air tankers, were available. Ground fire crews are generally capable of suppressing fires with flame lengths of less than 4 feet. Anything over 4 feet becomes a safety hazard to fire fighters. The higher the rate of spread of a fire, the more acres burned, and the more number of resources needed to suppress a fire.

Table 13. Potential fire behavior\(^a\) for the existing conditions under 90th percentile weather conditions and 90th percentile weather conditions with a 29 mph wind gust.

<table>
<thead>
<tr>
<th>Fuel Model</th>
<th>Weather</th>
<th>Type of Fire</th>
<th>Rate of Spread (ch/hr)</th>
<th>Flame Length (ft)</th>
<th>Fire Size (acres)</th>
<th>Scorch Height (ft)</th>
<th>Mortality (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TL2</td>
<td>90th</td>
<td>Surface</td>
<td>3.2</td>
<td>1.6</td>
<td>0.4</td>
<td>4</td>
<td>33-81</td>
</tr>
<tr>
<td></td>
<td>90th w/ 29 mph winds</td>
<td>Surface</td>
<td>8.7</td>
<td>2.6</td>
<td>1.9</td>
<td>4</td>
<td>33-81</td>
</tr>
<tr>
<td>TL2/GR2</td>
<td>90th</td>
<td>Surface</td>
<td>3.3</td>
<td>1.7</td>
<td>0.5</td>
<td>5</td>
<td>33-81</td>
</tr>
<tr>
<td></td>
<td>90th w/ 29 mph winds</td>
<td>Surface</td>
<td>8.7</td>
<td>2.7</td>
<td>1.9</td>
<td>5</td>
<td>33-81</td>
</tr>
<tr>
<td>GS1</td>
<td>90th</td>
<td>Surface</td>
<td>30.8</td>
<td>5.1</td>
<td>35.4</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>90th w/ 29 mph winds</td>
<td>Surface</td>
<td>98.1</td>
<td>8.6</td>
<td>196.2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>GR2</td>
<td>90th</td>
<td>Surface</td>
<td>70.6</td>
<td>6.5</td>
<td>186.5</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>90th w/ 29 mph winds</td>
<td>Surface</td>
<td>225.2</td>
<td>11.2</td>
<td>1,033.9</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

\(^a\) Results using BehavePlus 5.0.5.
The existing conditions in the mixed conifer (TL3/GS1) and some of the ponderosa stands (TL8/GS1) are favorable for intense fire behavior under 90th percentile weather conditions. The mixed conifer stands and some of the ponderosa stands have grass and shrubs in the understory. Grass and shrubs are fine flashy fuels that burn very easily. The flame lengths produced by the understory vegetation and low canopy base height creates an opportunity for fire to get into the crowns of the trees. “Crown fuels are the biomass available for crown fire, which can be propagated from a surface fire via understory shrubs and trees, or from crown to crown. The shrub/small tree stratum is also involved in crown fires by increasing surface fire intensity and serving as “ladder fuels” that provide continuity from the surface fuels to canopy fuels, thereby facilitating crown fires. These ladder fuels essentially bridge the vertical gap between surface and crown strata. The size of this gap is critical to ignition of crown fire from a surface fire below (Graham, et al 2004).” “Aerial fuels separated from surface fuels by large gaps are more difficult to ignite because of the distance above the surface fuels, thus requiring higher intensity surface fires, surface fires of longer duration that dry the canopy before ignition, or mass ignition from spotting over a wide area (Graham, et al 2004).” “Canopy base height, canopy bulk density, and canopy continuity are key characteristics of forest structure that affect the initiation and propagation of crown fire (Graham, et al 2004).” Forest treatments that target height to live crown and bulk density can be implemented to reduce the probability of crown fire (Graham, et al 2004).” Passive fire would be expected in all these stands under 90th percentile weather conditions. Active crown fire would be expected when winds reach about 18 mph in the ponderosa stands and 13 mph in the mixed conifer stands. Ground suppression crews would have some difficulty suppressing fires in these stands under 90th percentile weather conditions. When the winds increase, ground suppression crews would have to disengage because it would become too dangerous for them.

The ponderosa pine stands (TL8) have loosely packed needle cast in the understory. This needle cast allows fire to move rather quickly through these stands. The needle cast coupled with low canopy base height, passive fires could be expected under 90th percentile weather. These stands could also become active crown fires with about 30 mph winds.
Table 14. Potential fire behavior\(^a\) for the existing conditions under 90\(^{th}\) percentile weather conditions and 90\(^{th}\) percentile weather conditions with a 29 mph wind gust.

<table>
<thead>
<tr>
<th>Fuel Mode</th>
<th>Weather</th>
<th>Type of Fire</th>
<th>Rate of Spread (ch/hr)</th>
<th>Flame Length (ft)</th>
<th>Torching Index (mi/hr)</th>
<th>Crowning Index (mi/hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TL1(^b)</td>
<td>90(^{th}) Surface</td>
<td>1</td>
<td>0.7</td>
<td>36.9</td>
<td>17.7</td>
<td></td>
</tr>
<tr>
<td>TL1(^b)</td>
<td>90(^{th}) w/ 29 mph winds</td>
<td>Condition Crown</td>
<td>150.7</td>
<td>52.7</td>
<td>36.9</td>
<td>17.7</td>
</tr>
<tr>
<td>TL1(^c)</td>
<td>90(^{th}) Passive</td>
<td>24.2</td>
<td>8.2</td>
<td>5.9</td>
<td>17.7</td>
<td></td>
</tr>
<tr>
<td>TL1/GR2(^b)</td>
<td>90(^{th}) w/ 29 mph winds</td>
<td>Active Crown</td>
<td>150.7</td>
<td>52.7</td>
<td>5.9</td>
<td>17.7</td>
</tr>
<tr>
<td>TL1/GR2(^c)</td>
<td>90(^{th}) Passive</td>
<td>63.1</td>
<td>7.2</td>
<td>0</td>
<td>13.3</td>
<td></td>
</tr>
<tr>
<td>TL1/GR2(^c)</td>
<td>90(^{th}) w/ 29 mph winds</td>
<td>Active Crown</td>
<td>225.2</td>
<td>13.4</td>
<td>0</td>
<td>13.3</td>
</tr>
<tr>
<td>TL3/GS1</td>
<td>90(^{th}) Passive</td>
<td>63.1</td>
<td>7.2</td>
<td>0</td>
<td>13.3</td>
<td></td>
</tr>
<tr>
<td>TL3/GS1</td>
<td>90(^{th}) w/ 29 mph winds</td>
<td>Passive</td>
<td>12.9</td>
<td>3.5</td>
<td>0</td>
<td>29.3</td>
</tr>
<tr>
<td>TL8</td>
<td>90(^{th}) Passive</td>
<td>47.9</td>
<td>29.7</td>
<td>0</td>
<td>12.6</td>
<td></td>
</tr>
<tr>
<td>TL8/GS1</td>
<td>90(^{th}) w/ 29 mph winds</td>
<td>Active Crown</td>
<td>150.7</td>
<td>67.7</td>
<td>0</td>
<td>12.6</td>
</tr>
<tr>
<td>TL8/GS1</td>
<td>90(^{th}) Passive</td>
<td>21.9</td>
<td>7.3</td>
<td>0</td>
<td>18.6</td>
<td></td>
</tr>
</tbody>
</table>

\(^{a}\) Results using NEXUS 2.0.

\(^{b}\) Stands not infested by mountain pine beetles.

\(^{c}\) Stands affected by mountain pine beetles.

As the stands currently exist, wildfires within the project area could be catastrophic under the right weather conditions (Tables 13 & 14). Wildfires could pose a serious risk to fire fighter and public safety as well as infrastructure within and surrounding the project area.

**Cumulative Effects**

The cumulative effects of the no action alternative are continued buildup of surface fuel loads and an increase in ladder fuels leading to a potentially large wildfire under the right weather conditions.
It is predicted that the Mountain Pine Beetle infestation will continue to infest areas east of the Continental Divide including within the project area over the next 3-5 years. The infestation is expected to affect all the lodgepole pine and eventually kill the trees. With more acres of dead lodgepole pine, comes more opportunity for a large catastrophic wildfire under much lower percentile weather conditions. As time progresses, these dead trees will start to fall creating a large jackpot of fuel.

**Alternative B – Proposed Action**

**Direct and Indirect Effects**

The proposed action would be treating approximately 5,380 acres (968 acres broadcast burned, 2,368 acres clear-cut/patch clear-cut, 1,540 acres thinned, 296 acres of meadow enhancement, and 209 acres of quaking aspen enhancement). The material from the thinning and clearcutting would be chipped, masticated, and/or removed as forest product biomass to help decrease the fire hazard adjacent to the private land. Pile burning would be the least preferred method of removing the created slash. In some cases, where material cannot be disposed of in another way, the created and/or existing slash may not be enough to create a minimum pile size in which case the material would be lopped and scattered. Material thinned in the units within the southern-most broadcast burn units may be lopped and scattered and would be burned with the broadcast burn.

Based on analysis, the proposed treatments would reduce the high fuel hazard by approximately 8 percent across the project area and 12 percent within the treatment units. The very high fuel hazard risk would reduce by approximately 24 percent across the project area and 69 percent within the treatment units. This reduction in high and very high fuel hazards would increase the moderate and low fuel hazards by approximately 18 percent across the project area and 29 percent within the units. In other words, those acres treated would change from high and very high fuel hazards and be redistributed to low and moderate fuel hazards (Table 15).

<table>
<thead>
<tr>
<th>Fuel Hazard</th>
<th>Project Area</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Before Treatment</td>
<td>After Treatment</td>
</tr>
<tr>
<td>Low</td>
<td>1,295</td>
<td>1,296</td>
</tr>
<tr>
<td>Moderate</td>
<td>2,779</td>
<td>3,506</td>
</tr>
<tr>
<td>High</td>
<td>3,189</td>
<td>2,931</td>
</tr>
<tr>
<td>Very High</td>
<td>1,980</td>
<td>1,510</td>
</tr>
</tbody>
</table>

The existing stands within the treatment units would change based on the type of treatment. The meadow enhancement units would be best represented by fuel models GS1 and GR2 after treatment and TL2 and TL2/GR2 would best represent the post treatment fuel models in the quaking aspen enhancement units. Those stands that were TL8 or TL8/GS1 before thinning would remain as such. The TL3/GS1 stands would become TL1/GS1 after thinning (Table 16).
Table 16. Pre and post treatment fuel models by treatment type.

<table>
<thead>
<tr>
<th>Treatment Type</th>
<th>Pre-Treatment Fuel Model</th>
<th>Post Treatment Fuel Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meadow Enhancement</td>
<td>GR2</td>
<td>GR2</td>
</tr>
<tr>
<td></td>
<td>GS1</td>
<td>GS1</td>
</tr>
<tr>
<td>Quaking aspen Enhancement</td>
<td>TL2/GR2</td>
<td>TL2/GR2</td>
</tr>
<tr>
<td>Thin</td>
<td>TL8</td>
<td>TL8</td>
</tr>
<tr>
<td></td>
<td>TL8/GS1</td>
<td>TL8/GS1</td>
</tr>
<tr>
<td></td>
<td>TL3/GS1</td>
<td>TL1/GS1</td>
</tr>
<tr>
<td>Clearcut/ Patch Clearcut</td>
<td>TL1</td>
<td>SB1</td>
</tr>
<tr>
<td></td>
<td>(for 1-3 years using whole tree skidding)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TL1</td>
<td>SB3</td>
</tr>
<tr>
<td></td>
<td>(for 1-3 years without whole tree skidding)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TL1/GR2</td>
<td>SB1</td>
</tr>
<tr>
<td></td>
<td>(for 1-3 years using whole tree skidding)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TL1/GR2</td>
<td>SB3</td>
</tr>
<tr>
<td></td>
<td>(for 1-3 years without whole tree skidding)</td>
<td></td>
</tr>
<tr>
<td>Broadcast Burn</td>
<td>TL8</td>
<td>TL8</td>
</tr>
<tr>
<td></td>
<td>TL8/GS1</td>
<td>TL8/GR2</td>
</tr>
<tr>
<td></td>
<td>TL3/SB1</td>
<td>TL1/GR2</td>
</tr>
<tr>
<td></td>
<td>TL3/SB2</td>
<td>TL1/GR2</td>
</tr>
</tbody>
</table>

The 90th percentile weather conditions used for the Alternative A analysis were also used for the analysis of the proposed action. BehavePlus 5.0.5 and NEXUS 2.0 were also used for modeling fire behavior in the stands post treatment. The estimated canopy bulk densities used to model post treatment conditions were: 0.0065 lb/ft³ (0.104 kg/m³) for the ponderosa pine stands (using Ponderosa Pine 50% of Initial Basal Area); 0 lb/ft³ (0 kg/m³) for pure lodgepole pine stands clear-cut due to mountain pine beetle infestation; and 0.0034 lb/ft³ (0.055 kg/m³) for the mixed conifer stands thinned within and outside of the broadcast burn unit (using Ponderosa Pine 75% of Initial Basal Area). These canopy bulk densities were based on a study (“Stereo Photo Guide for Estimating Canopy Fuel Characteristics in Conifer Forests”) done by Joe Scott and Elizabeth Reinhardt in ponderosa pine, Douglas-fir, lodgepole pine, and mixed conifer stands in Arizona, Montana, Idaho, and California (Scott and Reinhardt, March 2005).
Table 17. Potential fire behavior\(^a\) for post treatment conditions under 90\(^{th}\) percentile weather conditions and 90\(^{th}\) percentile weather conditions with a 29 mph wind gust.

<table>
<thead>
<tr>
<th>Fuel Model</th>
<th>Weather</th>
<th>Type of Fire</th>
<th>Rate of Spread (ch/hr)</th>
<th>Flame Length (ft)</th>
<th>Fire Size (acres)</th>
<th>Scorch Height (ft)</th>
<th>Mortality (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TL2</td>
<td>90(^{th}) Surface</td>
<td>3.2</td>
<td>1.6</td>
<td>0.4</td>
<td>4</td>
<td>33-81</td>
<td></td>
</tr>
<tr>
<td>TL2</td>
<td>90(^{th}) w/ 29 mph winds Surface</td>
<td>8.7</td>
<td>2.6</td>
<td>1.9</td>
<td>4</td>
<td>33-81</td>
<td></td>
</tr>
<tr>
<td>TL2/GR2</td>
<td>90(^{th}) Surface</td>
<td>3.3</td>
<td>1.7</td>
<td>0.5</td>
<td>5</td>
<td>33-81</td>
<td></td>
</tr>
<tr>
<td>TL2/GR2</td>
<td>90(^{th}) w/ 29 mph winds Surface</td>
<td>8.7</td>
<td>2.7</td>
<td>1.9</td>
<td>5</td>
<td>33-81</td>
<td></td>
</tr>
<tr>
<td>GS1</td>
<td>90(^{th}) Surface</td>
<td>30.8</td>
<td>5.1</td>
<td>35.4</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>GS1</td>
<td>90(^{th}) w/ 29 mph winds Surface</td>
<td>98.1</td>
<td>8.6</td>
<td>196.2</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>GR2</td>
<td>90(^{th}) Surface</td>
<td>70.6</td>
<td>6.5</td>
<td>186.5</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>GR2</td>
<td>90(^{th}) w/ 29 mph winds Surface</td>
<td>225.2</td>
<td>11.2</td>
<td>1,033.9</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>SB1(^b)</td>
<td>90(^{th}) Surface</td>
<td>9.3</td>
<td>4.0</td>
<td>3.2</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>SB1(^b)</td>
<td>90(^{th}) w/ 29 mph winds Surface</td>
<td>26.3</td>
<td>6.4</td>
<td>14.0</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>SB3(^c)</td>
<td>90(^{th}) Surface</td>
<td>40.9</td>
<td>11.8</td>
<td>62.1</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>SB3(^c)</td>
<td>90(^{th}) w/ 29 mph winds Surface</td>
<td>130.1</td>
<td>20.1</td>
<td>344.5</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>TL3</td>
<td>90(^{th}) Surface</td>
<td>1.9</td>
<td>1.2</td>
<td>0.2</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>TL3</td>
<td>90(^{th}) w/ 29 mph winds Surface</td>
<td>4.9</td>
<td>1.8</td>
<td>0.6</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

\(^a\) Results using BehavePlus 5.0.5.  
\(^b\) Fuel model to simulate fire behavior for whole tree skidding.  
\(^c\) Fuel model to simulate fire behavior in stands where whole tree skidding is not done.

The proposed treatment within the quaking aspen stands (TL2 and TL2/GR2) is to remove the conifers within these stands. The predicted fire behavior is expected to be the same as is shown in the pre-treated stands (Table 17). Fires would continue to be slower burning and have a low intensity under 90\(^{th}\) percentile weather conditions. Ground suppression resources would have little difficulty suppressing fire within these stands.

Conifers would also be removed in the meadow enhancement areas (GS1 and GR2). Fire behavior under 90\(^{th}\) percentile weather conditions would remain the same as the existing conditions (Table 17). Higher flame lengths and very fast rates of spread would be expected.
Ground fire crews are generally capable of suppressing fires with flame lengths of less than 4 feet. Anything over 4 feet becomes a safety hazard to fire fighters.

The TL8 and TL8/GS1 fuel models would not change based on the thinning treatment. The TL3/GS1 fuel model would change to a TL1/GS1 fuel model post treatment (Table 18). The proposed treatment of thinning, in conjunction with offsite removal and/or chipping and/or masticating and/or pile and burning the created and existing slash, would help to disrupt the potential for a ground fire to propagate to a crown fire. However, the proposed treatments within the thinning units do not show a significant change in surface fire behavior from the existing condition because of the grass and shrub understory (Table 17). The main difference between the existing conditions and post treatment fire behavior is that stands post treatment would be more surface fire rather than passive as is potential in the pretreated stands. The abundance of shrubs and grass within the area are the primary carrier of fire within these stands. The thinning would target the trees as they relate to ladder fuels and the ability to initiate a crown fire. The treatments would also increase the canopy base height of the stand helping to increase the space between the surface fuels and the remaining standing trees. “Used alone, thinning especially directed at the smaller and medium-sized trees, can be quite effective in reducing the conditions conducive to crown fire spread (Influence of Forest Structure on Wildfire Behavior and the Severity of Its Effects, An Overview, May 2003).

Table 18. Potential fire behavior\(^a\) for post treatment conditions under 90\(^{th}\) percentile weather conditions and 90\(^{th}\) percentile weather conditions with a 29 mph wind gust.

<table>
<thead>
<tr>
<th>Fuel Mode</th>
<th>Weather</th>
<th>Type of Fire</th>
<th>Rate of Spread (ch/hr)</th>
<th>Flame Length (ft)</th>
<th>Torching Index (mi/hr)</th>
<th>Crowning Index (mi/hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TL1/ GS1</td>
<td>90(^{th})</td>
<td>Surface</td>
<td>1.0</td>
<td>0.7</td>
<td>23.3</td>
<td>41.9</td>
</tr>
<tr>
<td></td>
<td>90(^{th}) w/ 29 mph winds</td>
<td>Surface</td>
<td>1.6</td>
<td>0.8</td>
<td>23.3</td>
<td>41.9</td>
</tr>
<tr>
<td>TL8</td>
<td>90(^{th})</td>
<td>Surface</td>
<td>6.7</td>
<td>3.8</td>
<td>27.8</td>
<td>18.8</td>
</tr>
<tr>
<td></td>
<td>90(^{th}) w/ 29 mph winds</td>
<td>Active Crown</td>
<td>150.7</td>
<td>52.6</td>
<td>27.8</td>
<td>18.8</td>
</tr>
<tr>
<td>TL8/ GS1</td>
<td>90(^{th})</td>
<td>Passive</td>
<td>16.5</td>
<td>6.1</td>
<td>0</td>
<td>26.3</td>
</tr>
<tr>
<td></td>
<td>90(^{th}) w/ 29 mph winds</td>
<td>Active Crown</td>
<td>98.1</td>
<td>15.2</td>
<td>0</td>
<td>26.3</td>
</tr>
</tbody>
</table>

\(^a\) Results using NEXUS 2.0.
\(^b\) Stands not infested by mountain pine beetles.
\(^c\) Stands affected by mountain pine beetles.

The stands that would be clear-cut/patch clear-cut would change to a TL3 fuel model 3-10 years post treatment depending on slash treatment. In the first three years after the implementation of the proposed treatments, a slash fuel model more accurately describes the potential conditions. In areas where whole tree skidding would be used, a SB1 (Low Load Activity Fuel) fuel model would best represent the area post implementation. In areas where whole tree skidding is not...
done, a SB3 (High Load Activity Fuel or Moderate Load Blowdown) fuel model would best represent the area post implementation (Table 18).

Clearcutting (the use of sanitation and removal treatment) the infested lodgepole pine stands helps to decrease the threat of crown fires across the treatment unit for several years. However, depending on how the slash is dealt with, fire behavior could increase substantially if not treated properly (Table 18). Where whole tree skidding would be used, fire behavior would be decreased to a manageable rate of spread. Whole tree skidding consists of removing the entire tree from the stand and processing it at a landing, in turn leaving less slash in the unit. Where whole tree skidding would not be used, the fire behavior becomes so intense that ground resources would not be able to take direct suppression efforts. When whole tree skidding is not done, the amount of slash left behind in the unit would propel a wildfire under 90\(^{th}\) percentile weather conditions.

Passive fire could be expected in these stands under 90\(^{th}\) percentile weather conditions once the regeneration begins to occupy the site (10+ years post treatment). This is dependent on the canopy base height of the new stand. After about 10 years, the regeneration should be on the site and growing. As the regeneration grows the distance between the surface fuels and the crown increases and the fire behavior decreases (Table 18).

The stands in the northernmost broadcast burn unit would have thinning done prior to the broadcast burn and the material would be removed prior to burning. These stands would go from TL8 and TL8/GS1 to TL8 and TL8/GR2 post burn. The stands in the southernmost burn unit would also be thinned, but the created slash would be lopped and scattered and burned when the unit was burned. These stands would go from TL3/SB1 and TL3/SB2 (Moderate Load Activity Fuel or Low Load Blowdown) to TL1/GR2 after burning (Table 19).

The location of the broadcast burn unit boundaries is based on control features surrounding the primary burn areas, including forest roads and Gross Reservoir. For safety and logistical purposes, a secondary burn area would be established surrounding the primary burn area. This area is located adjacent to the primary burn area, unless there is private property immediately adjacent, using predefined on the ground areas where fire could burn but is not targeted for burning. In the secondary burn area, fire would be allowed to spread without the aid of active ignition and provides a buffer between target and non-target areas. This is to alleviate having to call a fire outside the primary burn area an escaped fire where resources would be assigned to actively suppress the fire.

<table>
<thead>
<tr>
<th>Fuel Model</th>
<th>Type of Fire</th>
<th>Rate of Spread (ch/hr)</th>
<th>Flame Length (ft)</th>
<th>Scorch Height (ft)</th>
<th>Mortality (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TL8</td>
<td>Surface</td>
<td>3.2</td>
<td>2.6</td>
<td>12</td>
<td>10</td>
</tr>
<tr>
<td>TL8/GS1</td>
<td>Surface</td>
<td>7.1</td>
<td>2.6</td>
<td>13</td>
<td>10</td>
</tr>
<tr>
<td>TL3/SB1</td>
<td>Surface</td>
<td>2.7</td>
<td>2.7</td>
<td>13</td>
<td>10</td>
</tr>
<tr>
<td>TL3/SB2</td>
<td>Surface</td>
<td>5.0</td>
<td>5.2</td>
<td>36</td>
<td>77</td>
</tr>
</tbody>
</table>

\(^a\) Results using BehavePlus 5.0.5.
BehavePlus 5.0.5 was used to predict potential fire behavior during the broadcast burn (Table 19). The broadcast burn would be done when weather conditions are favorable for burning. The shrub fields, including small diameter trees, ladder fuels and other understory vegetation, within the broadcast burn units could expect to have up to 75% mortality with the larger diameter trees and dominant trees seeing up to 25% mortality. The areas of mortality would be scattered across the burn units based on burnable material. Expected total area burned would be up to 80%.

Thinning is most effective if done with a surface treatment such as broadcast burning which removes the grass and shrub understory lessening the potential fire behavior. 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, McCaffrey and Jain, April 2004).

Table 20. Potential fire behavior\(^a\) post broadcast burn under 90\(^{th}\) percentile weather conditions and 90\(^{th}\) percentile weather conditions with a 29 mph wind gust.

<table>
<thead>
<tr>
<th>Fuel Model</th>
<th>Weather</th>
<th>Type of Fire</th>
<th>Rate of Spread (ch/hr)</th>
<th>Flame Length (ft)</th>
<th>Fire Size (acres)</th>
<th>Scorch Height (ft)</th>
<th>Mortality (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TL8</td>
<td>90(^{th})</td>
<td>Surface</td>
<td>6.7</td>
<td>3.8</td>
<td>1.9</td>
<td>22</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>90(^{th}) w/ 29 mph winds</td>
<td>Condition al Crown</td>
<td>17.9</td>
<td>5.9</td>
<td>8.0</td>
<td>28</td>
<td>0</td>
</tr>
<tr>
<td>TL8/GR2</td>
<td>90(^{th})</td>
<td>Surface</td>
<td>25.1</td>
<td>5.6</td>
<td>27.3</td>
<td>44</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>90(^{th}) w/ 29 mph winds</td>
<td>Condition al Crown</td>
<td>69.7</td>
<td>9.3</td>
<td>121.6</td>
<td>72</td>
<td>80</td>
</tr>
<tr>
<td>TL1/GR2</td>
<td>90(^{th})</td>
<td>Surface</td>
<td>19.8</td>
<td>5.6</td>
<td>17.0</td>
<td>44</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>90(^{th}) w/ 29 mph winds</td>
<td>Surface</td>
<td>54.1</td>
<td>9.3</td>
<td>99.8</td>
<td>72</td>
<td>80</td>
</tr>
</tbody>
</table>

\(^a\) Results using BehavePlus 5.0.5.

The stands after burning show a significant drop in fire behavior by thinning the ladder fuels and burning the grass/shrub components (Table 20). Doing these treatments opens the stands up in turn allowing more wind to come to the surface. With more wind higher fire behavior could be expected.

Overall, the treatments proposed within the project area would change the fire behavior in those areas that would be treated helping to reduce the threat of a catastrophic wildfire.

**Cumulative Effects**

Cumulatively over time, the areas that would have ladder fuels removed would have to be retreated. It may take 5 - 10 years before treatment needs to reoccur. The regeneration that would be expected to occur would need to be thinned to continue to keep those areas within a desired
condition. These re-treatments may need to occur within 10 years of completion of the project depending on tree growth in that timeframe. “A single thinning treatment cannot maintain lowered wildfire risk over the long term…” (Recent Forest Insect Outbreaks and Fire Risk in Colorado Forests: A Brief Synthesis of Relevant Research, 2006).

The area treated by burning would need to be re-evaluated for maintenance burning within 15 to 25 years from its first application. This would be to help keep fire in the ecosystem and to keep the shrubbery and ladder fuels at a minimum. The shrub component may take 10 – 15 years to regenerate post burning, but the grasses would be replenished the following growing season with adequate moisture. “Although low-intensity prescribed burns reduce fine fuels in the short-term, they also contribute to subsequent dead fuels by killing understory trees, which can result in fuel levels that exceed pre-burn levels within a decade. Therefore, repeated or staged prescribed fire or mechanical thinning treatments are essential for maintaining lower forest densities; otherwise, a one-time thinning may facilitate a dense tree establishment” (Recent Forest Insect Outbreaks and Fire Risk in Colorado Forests: A Brief Synthesis of Relevant Research, 2006).

No major projects are adjacent to the project area besides some activities occurring in the Lump Gulch and Yankee Hill projects. The little that has been done in conjunction with the proposed treatments would help decrease the amount of fuel buildup when the Mountain Pine Beetle infestation occurs across the landscape.

**Biological Environment**

This section describes the affected environment and environmental consequences for each alternative to the Biological Environment (Vegetation, Noxious Weeds, Wildlife, and Botany).

**Vegetation**

**Affected Environment**

**Past Actions affecting existing condition of Silviculture/Timber:**

Records indicate that minimal harvesting within the project area has occurred as far back as the turn of the twentieth century. Since that time, additional minimal harvesting has occurred on a periodic basis. Some of the area has had vegetative treatments within the past 20 years. Activity that has occurred within the project area includes:
Table 21 - Approximate Acres for Past Activities: (Activities recorded since 1974)

<table>
<thead>
<tr>
<th>Activity Description</th>
<th>Acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial Thin</td>
<td>108</td>
</tr>
<tr>
<td>Fuel Break</td>
<td>28</td>
</tr>
<tr>
<td>Patch Clear-cut</td>
<td>152</td>
</tr>
<tr>
<td>Precommercial Thin</td>
<td>41</td>
</tr>
<tr>
<td>Sanitation/Salvage</td>
<td>308</td>
</tr>
<tr>
<td>Shelterwood Prep Cut</td>
<td>431</td>
</tr>
<tr>
<td>Individual Tree Selection</td>
<td>331</td>
</tr>
<tr>
<td>Burning of Piled Material</td>
<td>3</td>
</tr>
<tr>
<td>Chipping of Activity Fuels</td>
<td>17</td>
</tr>
<tr>
<td>Group Selection</td>
<td>24</td>
</tr>
<tr>
<td>Stand Exam Data Collection (1980s)</td>
<td>1519</td>
</tr>
</tbody>
</table>

The Winiger Ridge Ecosystem Management Project was implemented by the Boulder Ranger District of the Arapaho and Roosevelt National Forests for vegetation management treatment within a 9,563 acre project area in the vicinity of Nederland and Rollinsville, Colorado. The Forest Service proposed to apply vegetation management treatments on approximately 2,475 acres of NFS lands. The project area includes NFS lands within the South Boulder Creek watershed located east of the Peak to Peak Highway (State Highway 119). The project area overlaps and abuts the Proposed Action. This action has been started and is nearly complete with some piles left to burn.

The Forsythe Fuels Reduction Project has yet to be implemented by the Boulder Ranger District of the Arapaho and Roosevelt National Forests for hazardous fuel reduction treatment within an 11,787 acre project area in the vicinity of Rollinsville, Colorado. The Forest Service proposed to apply vegetation management treatments on approximately 1,642 acres of NFS lands. The project area includes NFS lands within the South Boulder Creek watershed located west of the Peak to Peak Highway (State Highway 119). The project area overlaps and abuts the Proposed Action. This action has been started but is not complete.

**Present (Existing) Conditions of the Forest Resource:**

**Topography:**
The topography is broken with many large drainages leading into the larger and more developed drainages of South Boulder Creek. Elevations run from a low of 6,300 feet in valleys to over 8,800 feet on some of the ridge tops. Slopes are moderate over most of the area with an average slope of 26%.

**Fuel-loading:**
Approximately 16 percent of National Forest System land, 1,443 acres, within the project area has had mechanical treatments to reduce the crown spacing to a level that would minimized crown fire spread.
Cover Type Composition:
Cover type composition is presented below. There are numerous small inclusions (10 acres or less in size) of quaking aspen or oak located in non-quaking aspen or oak sites. These are usually very productive sites where conifers would eventually take over the site if no treatment is completed. In addition, there are 1,485 acres of forb, grass, or shrub cover types which may have conifers encroachment.

Table 22 - Cover Types

<table>
<thead>
<tr>
<th>Cover Type</th>
<th>Acres</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forb</td>
<td>382</td>
<td>4%</td>
</tr>
<tr>
<td>Grass</td>
<td>478</td>
<td>5%</td>
</tr>
<tr>
<td>Unvegetated (Rock or Barren)</td>
<td>60</td>
<td>1%</td>
</tr>
<tr>
<td>Shrub</td>
<td>625</td>
<td>7%</td>
</tr>
<tr>
<td>Quaking aspen</td>
<td>395</td>
<td>4%</td>
</tr>
<tr>
<td>Douglas-fir</td>
<td>892</td>
<td>10%</td>
</tr>
<tr>
<td>Lodgepole Pine</td>
<td>3184</td>
<td>34%</td>
</tr>
<tr>
<td>Limber Pine</td>
<td>6</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>Rocky Mountain Juniper</td>
<td>335</td>
<td>4%</td>
</tr>
<tr>
<td>Ponderosa Pine</td>
<td>2731</td>
<td>30%</td>
</tr>
<tr>
<td>Spruce/Fir</td>
<td>3</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>Water</td>
<td>167</td>
<td>2%</td>
</tr>
<tr>
<td>TOTALS</td>
<td>9267</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 23 – Structural Stage Acreage by Cover Type

<table>
<thead>
<tr>
<th>Structural Stage</th>
<th>DOUGLAS-FIR</th>
<th>LODGEPOLE PINE</th>
<th>PONDEROSA PINE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2T</td>
<td>0</td>
<td>35</td>
<td>0</td>
</tr>
<tr>
<td>3A</td>
<td>276</td>
<td>270</td>
<td>719</td>
</tr>
<tr>
<td>3B</td>
<td>294</td>
<td>1567</td>
<td>587</td>
</tr>
<tr>
<td>3C</td>
<td>133</td>
<td>755</td>
<td>50</td>
</tr>
<tr>
<td>4A</td>
<td>63</td>
<td>27</td>
<td>584</td>
</tr>
<tr>
<td>4B</td>
<td>64</td>
<td>382</td>
<td>564</td>
</tr>
<tr>
<td>4C</td>
<td>62</td>
<td>148</td>
<td>227</td>
</tr>
<tr>
<td>TOTALS</td>
<td>892</td>
<td>3184</td>
<td>2731</td>
</tr>
</tbody>
</table>

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.
**Forest Vegetation**

**Lodgepole Pine**
The lodgepole pine cover type covers approximately 34 percent of the project area. Data suggests the majority of lodgepole pine stands to be homogeneous in age, size, and structure across individual stands and the landscape.

Lodgepole pine is a prolific seed producer and good crops are expected at 1 to 3 year intervals. Seed crops from serotinous cones are large and result in prolific stocking densities. In areas affected by MPB mortality, rapid colonization of lodgepole sites without fire may be delayed. A serotinous cone seed source would be adequate to restock a stand in the absence of fire if an adequate amount of cones are left on-site and activity created slash is not concentrated in one location (lop and scattered slash treatment). Cones must be approximately ½ to 1 foot above the ground depending upon aspect in order that solar warming is high enough to open the cones. In the absence of a natural or prescribed fire, the open cone habit would normally be expected to gradually reestablish a site. Regeneration under this scenario would be somewhat dependent upon the proximity of younger stands with an open cone seed source that have not had high levels of beetle related mortality.

**Ponderosa Pine**
The ponderosa pine cover type covers approximately 30 percent of the project area. Data suggests that the majority of ponderosa pine stands are mixed in age, density, and structure across the landscape. Most ponderosa pine stands are interspersed with Douglas-fir. In the majority of these stands, Douglas-fir is outcompeting ponderosa pine due to its prolific seeding ability.

Regeneration is occurring in the project area where the crown canopy is open and where competition from grasses, forbs, and Douglas-fir is low. Regeneration activities within the project area should be designed to reduce ground cover competition and expose mineral soil, increasing natural regeneration potential and removal of Douglas-fir from stands. In stands that are scheduled for fuels treatment, prescribed burning must be implemented at intensities and severities that minimize mortality of residual large diameter ponderosa pine. Large scale tree mortality due to mountain pine beetle would directly affect the ability for regeneration to occur. In stands that are not fully stocked in the understory where the overstory has been killed from MPB, regeneration may take 20 to 30 years to establish. However, this depends on the extent of tree mortality from MPB at a landscape scale. Since the stands within the project area are at high hazard to infestations of MPB, the seed source could be eliminated in the worst case scenario. In stands that are stocked in the understory where MPB killed the overstory, the understory would not be affected by mountain pine beetle and would become the future forest.

**Douglas-fir**
The Douglas-fir cover type covers approximately 10 percent of the project area. Data suggests that the majority of Douglas-fir stands are former stands of ponderosa pine which were overtaken by Douglas-fir due to its ability to prolifically seed in quicker than ponderosa pine.
Regeneration is occurring in the project area where the crown canopy is open and where competition from grasses and forbs is low. In ponderosa pine stands that could be killed by MPB, it is possible that Douglas-fir could fully establish and become dominant tree species.

**Quaking aspen**

Quaking aspen occurs at various elevations throughout the project area. The majority of the quaking aspen stands are seral communities that would eventually be dominated by conifers in the absence of a major disturbance. These communities often have conifers in the understory at low to moderate densities. This presence would increase as succession progresses away from dominance by quaking aspen in the absence of disturbance. In the analysis area, ponderosa pine, Douglas-fir, or lodgepole pine is the next dominant species in succession following quaking aspen, although Rocky Mountain juniper, subalpine fir, Engelmann spruce, and blue spruce are present in smaller amounts.

**Insects & Disease:**
The insect of greatest concern in this area now is MPB. Stands of pine with an average diameter of four inches and a basal area (in square feet per acre) of 74 or greater are susceptible to MPB (Negron, 2003). There has been an increasing population of MPB and associated increases in tree mortality over the past 2 years in the Boulder Creek watershed, the areas surrounding Nederland, the Winiger Ridge area and along the Peak to Peak Road. The best silvicultural approach to reducing losses to the mountain pine beetle for the long term is forest management to reduce stocking densities to below that which favor mpb.

Decreases in stocking densities would lower the probability that beetle outbreaks would be initiated, but it is a continual process to keep stands in the low hazard category. To minimize tree mortality to mountain pine beetle, it would be necessary to treat the stands in a timely and aggressive manner. Thinning stands to 40-80 square feet of basal area in ponderosa pine and group selections and patch-cuts in lodgepole pine would offer better and longer-term protection.

The disease of concern is Dwarf mistletoe (*Arceuthobium spp.*) is a parasitic plant that is the most widespread and damaging disease agent in lodgepole, ponderosa, and limber pine throughout their ranges. Heavy mistletoe infections adversely impact tree and stand vigor by reducing rates of height and diameter growth and seed and cone production. Pockets of heavy infections are present across the analysis area.

**Environmental Consequences**

**Alternative A – No Action**

**Direct and Indirect Effects**

**Direct and Indirect Effects on Silviculture/Timber:**
Under this alternative, no fuels management activities would occur, other than ongoing activities such as hazard tree removal, firewood gathering, right-of-way clearing, Christmas tree cutting and some minor vegetation treatments for other resource purposes. There are state and county rights-of-way throughout the planning area. Hazard trees and timber within these right-of-ways
would be removed to reduce the risk to motorists and to “daylight” the roads or reduce icing on the roads. Timber may be removed with small sales, or in the case of very small quantities or if it’s unmerchantable timber, the timber may be removed as administrative free use. The effects of removing this timber would be minimal. Public safety would be improved by the removal of hazard trees that could fall on the roads; removing shade in some areas may reduce winter icing or allow quicker melting of ice and snow pack; and visibility around curves would be improved. The amount of volume removed would be insignificant and the impacts to the silviculture/timber resource almost non-measurable when compared to the project area.

**Insects & Disease:**
Based on current stand conditions, the overstocked stands of pine pose a high hazard for MPB infestation. This hazard would increase over time, with individual tree growth and as stocking levels increase. When this is added to the occurrence of high beetle populations in the area, the likelihood of a continuing widespread epidemic-level infestation of MPB is high. There are considerable changes in the landscape taking place within the Forsythe area due to MPB mortality. If no action is taken, many currently forested areas could lose most or all of their mature pine overstory. This loss of mature pine trees would add greatly to fuel loads and long-term wildfire hazard (see Fire and Fuels section), and cause substantial changes to wildlife habitat (see Wildlife section).

If not treated, the hazard should remain high until stocking levels decrease due to mortality from MPB activity or wildfire. It is not possible to determine exactly which stands could become infested or the precise level of MPB-caused mortality that will occur; however reasonable estimates can be made based on the current extent of the epidemic, the expanding MPB brood populations available to infest new trees, and the large volume and wide distribution of moderate to high hazard stands in the project area. What is apparent is that there could be considerable changes in the forested landscape in the Forsythe area.

With the lack of vegetation diversity in the area, a larger percentage of the forested area would be susceptible to MPB infestation. In addition, the large volume of dead and down trees significantly increases fuel loads and wildfire hazard in this wildland-urban interface (See Fire and Fuels section). This increases the probability for large, intense wildfires resistant to control and that threaten natural resources, private property, and human life.

In areas that currently have lower infestation levels, it is assumed they would also have lower overall mortality rates. This may not be the actual case, as the current epidemic could easily overwhelm the entire project area. In these areas, structural stage 4B and 4C stands are expected to have substantial MPB-caused mortality, with a high percentage being changed to structural stage 4A, and lesser amounts to younger structural stages 2 and 3.

If no action is taken, it is possible to envision that many of the areas that are forested at this point could easily lose most or all of their mature pine overstory. The MPB hazard decreases due to the beetle-caused mortality reducing stocking levels in all high hazard stands. Even though the MPB hazard would decrease, the fire hazard would increase due to the number of dead trees that would be present. The amount of heavy continuous fuels on the ground as the dead trees fall over time would create especially dangerous conditions.
The pine engraver beetle (*Ips pini*) is a non-aggressive bark beetle that breeds in damaged pine trees and slash greater than two inches in diameter. Unless severe drought, weather damage or fire damage occurs, the probability of a major buildup of these insects is very unlikely.

The disease of concern is Dwarf mistletoe is a parasitic plant that is the most widespread and damaging disease agent in lodgepole, ponderosa, and limber pine throughout their ranges. With increased stocking levels and a potential flush of new regeneration due to MPB mortality, it is expected that dwarf mistletoe would continue to affect the growth of pine species in the project area under the No-Action Alternative.

**Plant Species Composition:**
With no action, plant species composition and diversity would decrease. Conifers are encroaching into quaking aspen and meadow areas and filling in to small openings in the forest canopy. As time passes, the canopy closes, quaking aspen and other quaking aspen would diminish in numbers until disturbance open up the canopy. Within many sites, forbs and grasses in the understory would be shaded out reducing benefits to other resources such as wildlife, range, recreation and visuals.

**Other Effects:**
The effects of no action in the project area would be increased mortality and the resulting decrease in growth and yield due to the continuation of the MPB epidemic; reduction of diameter growth due to age and overstocking in stands not impacted by MPB activity; and an increase in the hazard for catastrophic wildfire. With no treatments, stands of the pine type would experience reduced growth due to overcrowding and competition for nutrients, water and light. Age class distribution would not change except for changes created through unpredictable natural processes such as insect infestations and wildfire. Long-term effects in stands not heavily impacted by MPB infestation would be an increase in mortality due to competition between pines an increase in merchantable defect due to disease, and an increased crown fire hazard. Long-term sustainability of the timber resource would be in jeopardy since much of the mature forest would be killed by MPB and relatively few acres currently young and available to grow into the next generation of mature forest. Periodic annual increment is declining in some of the stands and is less than desired due to overstocking and stand age. No Action would cause a further drop in the periodic annual increment. Net growth would remain positive, but it would be below its potential.

As the stands of pine become dense, they would also become susceptible to snow damage. Dense stands of pine with interlocking crowns cannot shed snow as well as open stands. During times of heavy snowfall and wind, snow can build up on the crowns of dense stands and cause heavy breakage. Stands with open canopies shed their snow as wind shakes them and are less susceptible to snow buildup.

The hazard of a stand replacing wildfire would be higher without treatment. Crown fires, such as the Four Mile fire of 2010 could cause many of the stands to be completely killed. The effect of such a catastrophic fire to the silviculture resource would a large reduction of age class distribution, an increase in insects, and a disruption of the natural regeneration process. Solarization would reduce the success of both natural and artificial regeneration. Soil
sterilization would reduce productivity for many years, as the process of rebuilding soil horizons in this relatively dry climate is slow.

Cumulative Effects

Past Activities and Their Effects on Silviculture/Timber:
Some of the area has had vegetative treatments within the past 20 years. Treatments from the late 1970’s through the mid 2000’s have taken place on approximately 16 percent of the project area. Many treatments were designed to lower the basal area to promote increased growth and vigor as well as regenerate the stands.

The effect of past treatments has been an increase of merchantable volume growth, increase in the quality of timber and until recently, a minimal amount of insect and disease infestations. The past treatments have reduced the stocking levels in overstocked stands. The effect has been an increase in the quality of the timber 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. Trees 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 Activities and Effects on Silviculture/Timber:
No major activities are occurring on National Forest System lands within the project area except for removal of hazard trees along roads and trails. Some treatments are occurring on private land within the project area, mostly in conjunction with development. Since private land comprises 49 percent of the project area (8,853 acres) and most of those areas are timbered, the effects of forest management practices could affect the project area. The amount of treatments during any one decade however has been small and its effects on National Forest forested areas should be minimal.

Proposed and/or Reasonably Foreseeable Activities and Their Effects on Silviculture/Timber:
Anticipated future silviculture activities, not connected to this analysis, that would occur within the area are as follows: Fuel breaks adjacent to developed private land may be created for protection of those improvements. Firewood gathering would continue to occur within the area. Other silvicultural treatments such as small firewood sales for the removal of storm damage, road right-of-way clearing, pine encroachment removal, quaking aspen regeneration and release may occur within the project area. The size of these projects would generally be small (less than 10 acres) and the cumulative effects of these projects should not be of any measurable significance.

Ongoing mechanical treatments and prescribed burning activities occurring on National Forest within the project area have similar effects to past treatments. This includes relatively small amounts of treatments on private land within the project area, mostly in conjunction with development. Anticipated future silviculture activities not connected to this analysis are minor in scope. The size of these projects would generally be small and the cumulative effects of these
projects should be very minor. Continuing development of private land and actions taken on private land to protect property from wildfire and mountain pine beetle could result in additional scattered openings and lower basal areas, but would have no major effect on the forested landscape within the project area.

The No Action Alternative could lead to significant changes on the landscape, and result in adverse cumulative effects to the forest resource. This includes the loss of mature pine trees over large areas with a consequent increase in fuel loads. This would set the stage for intense wildfires that could eliminate the forest cover from large areas within and adjacent to the project area. Past and present forest improvements would be negatively affected by ongoing MPB infestations and could be completely eliminated where wildfires occur.

**Activities that have a good probability of occurring on land within the Project area other than National Forest System Lands are as follows:**

With an increasing interest from landowners to manage their forested land, protect their property from fire and mountain pine beetle infestation; and clear land for home sites, acres may be treated within the next decade. 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. Treatments on private land for fire hazard reduction would contribute to both a reduction of hazard from catastrophic wildfire and MPB.

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.

**Alternative B – Proposed Action**

**Direct and Indirect Effects**

**Direct and Indirect Effects on Silviculture/Timber:**
Under this alternative, approximately 4,357 acres of National Forest System lands would be mechanically treated. Many of the stands in the project area have inclusions of less than 10 acres in size that may have basal areas, age classes, size classes and tree species (i.e. quaking aspen, ponderosa pine, lodgepole pine, Douglas-fir, Engelmann spruce, and subalpine fir) that differ from the majority of the stand. Actual treatment areas generally apply to 75 percent of proposed treatment areas. As these stands are laid out and marked these inclusions may not be prescribed and marked or treated as specified in the stand treatment table. Rather, prescribed using criteria developed for other stands with similar characteristics, i.e. an inclusion of ponderosa pine would be left and possibly thinned within a stand of lodgepole pine scheduled for group selection.

The law generally prohibits the harvest of stands before they reach their maximum growth rate (National Forest Management Act (NFMA), 16 U.S.C. 1604(m)). Exceptions in the law allow the harvest of individual trees, or even parts or whole stands of trees, before this time to thin and improve timber stands, and salvage damaged stands of trees (part m1 of the law). Further exceptions are allowed in order to achieve multiple-use objectives other than timber harvest (part
m2) such as structural stage, fuels, or wildlife objectives. This alternative would harvest some trees before the maximum potential growth rate of some stands in the project area has been reached. These harvest treatments are consistent with the exceptions provided in part m2 of the law, and include the following: Thinning, patch-cuts, and group selection which are designed to meet other resource objectives besides timber. These treatments are proposed to move towards meeting Forest Plan direction and respond to HFRA guidance.

**Lodgepole pine Treatments (TLP):**
Patch-cuts and/or Group Selections would occur on approximately 2,368 acres with groups or patches generally no larger than 5 acres. Group selections, and uneven-aged silviculture treatment, would affect no more than 20 percent of single lodgepole pine stands. Most of these stands are very dense and are homogeneous in age and structure. Breaking up the continuity of age classes and structures would be important at the landscape level to decrease the potential for large scale intense wildfire behavior and to reduce heavy MPB activity. Within patches or groups, the removal of the pine overstory would open up areas to be newly regenerated due to the serotiny of the lodgepole pine cone crop. All lodgepole pine 5 inches dbh and greater would be removed, retaining only lodgepole pine necessary for other resource needs while retaining ponderosa pine, limber pine, Douglas-fir, and quaking aspen inclusions where they exist.

Within ponderosa pine, limber pine, and Douglas-fir inclusions, these areas would be thinned down to generally 40 to 80 square feet of basal area per acre to reduce wildfire and MPB hazard.

In areas where there are ongoing beetle outbreaks, increases in patch and group sizes could result in even further through sanitation and salvage activities that encompass entire stands/hillsides similar to a clear-cut. Most areas where sanitation would occur, uninfested green trees would also be cut due to the high potential for blowdown if these trees were left standing within treated areas. MPB infested ponderosa pine and limber pine would also be removed to address the MPB epidemic and to remove the potential fuel hazard.

The effects of these treatments would result in an increase of acres of early successional, younger structural stage lodgepole pine, and an increase in growth of the remaining ponderosa pine, Douglas-fir, and limber pine; there would also be an increase in the establishment and production of forage for wildlife; aerial fuels would also be reduce, thereby reducing potential for fire spread from individual tree torching and associated spotting. Within patches and groups, lopping and scattering of slashing would be the preferred logging method due to the serotiny of the lodgepole pine cones.

**Ponderosa Pine Treatments (TPP):**
Thinning would occur on approximately 1,540 acres of the project area. Thinning would generally consist of removing ponderosa pine from below with the removal of most Douglas-fir, lodgepole pine, and Rocky Mountain juniper; and little to no limber pine. Densities would generally be 50 square feet of basal area (BA) with some stands reduced to lower or higher BA’s based on proximity to structures on private land, and communities. Skyline logging is not proposed under this alternative. In areas where there are ongoing beetle outbreaks, stand densities would be reduced even further through sanitation and salvage activities. Fire managers have determined a lower basal area and associated reduced bulk density of crown fuels reduce
the potential for catastrophic wildfires. Generally, the range of BA’s for commercial thinning would be from 40 to 80 square feet of BA. Leave trees in cutting units would generally not be uniformly spaced to create a more natural appearing stand. Whole tree skidding would be the preferred logging method to remove as much slash as possible during harvest activities.

The thinning would reduce the stocking levels in overstocked stands. There would also be an increase in individual tree growth by releasing the remaining trees from competition for light, water and nutrients. Over time, these trees would develop larger diameters due to a reduction of competition which concentrates the stand growth in fewer stems. A reduction in MPB hazard would also occur due to the reduction of basal area below the level of susceptibility to MPB attack. Total yield would not be maximized because the trees would not fully occupy the stand.

**Aspen Restoration (TAA):**
The restoration of approximately 209 acres of quaking aspen from conifer competition would occur in this alternative. Treatments removing all of the pine from quaking aspen would occur except for the removal of mature ponderosa pine, Douglas-fir, and limber pine (trees generally greater than 14” DBH). Quaking aspen stands would be enlarged to include adjacent pine stands that have encroached upon them. Pine would be removed from the area within 100 feet of the edge of the inclusion or, in the case of draws where there are remnants of past quaking aspen occupation, the pine would be removed to the boundary of the original stand which would normally be 33 feet to 100 feet. Small inclusions of established quaking aspen that are scattered throughout the stands scheduled for treatment would be restored by removing pine, juniper, and Douglas-fir from within and adjacent to the quaking aspen inclusions.

The effects of this treatment would be an increase in vegetative diversity and increased vigor of quaking aspen communities by release from the competition of pine, juniper, and Douglas-fir. Indirectly, the quaking aspen dependent wildlife species would have increased habitat. An additional indirect benefit would be the value of quaking aspen stands as natural fuel breaks.

**Meadow Enhancement (GRA):**
Pine encroaching in meadows would be removed on 296 acres. Treatments removing most of the pine from meadows would occur through manual means only. Mechanized equipment would not be used for this treatment due to the adverse impacts associated to grassland soils, hydrology, and vegetation. Most of these grass sites have only scattered individuals or small groups of conifers so the quantity of trees may be low. Small openings that are within some of the stands in the project area would be enlarged by removing pine from within and adjacent to the openings. In other areas of the project area meadows would be enlarged to include adjacent pine stands that have encroached into them. Generally, pine, Douglas-fir, and juniper would be removed from the area within up to 100 feet of the edge of the opening or, in the case of historic meadows, especially in draw bottoms, the pine would be removed to its original boundary as defined by soil type, slope, and moisture regime, which usually is less than 100 feet.

The effects of this treatment would be an increase in vegetative diversity and an increase in grass production in the meadow communities by the release from the competition of pine, Douglas-fir, and juniper. Indirectly, meadow dependent wildlife species would have increased habitat. An additional indirect benefit would be the value of meadows as fuel breaks.
Prescribed Broadcast Burning:
Moderate intensity broadcast prescribed burning would occur on up to 968 acres in the project area, reducing ground fuels and increasing vegetative diversity in the understory. In some of the stands, the understory vegetation is lacking due to closed canopy over and needle cast. Moderate intensity prescribed fire would reduce inhibiting duff and stimulate residual grasses and forbs. Broadcast prescribed burning should be designed to limit mortality in the pole size and sawtimber size pine stands within to 20 percent or less with seedling/sapling mortality generally less than 90 percent. Burning in stands to be regenerated would favor grass and forb establishment and reduce regeneration.

The effects of prescribed burning on the timber resource would be a short-term increase in growth from the nutrients released into the soil. Total yield in the project area would be reduced by the burn-related mortality. The reduction in yield should be minor for the project area due to low levels of mortality which have been common on prescribed burns completed in the past few years.

Insects & Disease:
Forest management actions that increase tree vigor and reduce stand susceptibility to beetle attack through reducing stocking levels are proposed. They are preventive treatments that should be completed prior to stands experiencing beetle outbreaks. Sanitation (removal of infested trees) can also provide protection to surrounding uninfested trees and stands by removing a large source of attacking beetles. Creating diverse stand conditions across the landscape would result in forest conditions that are less susceptible to long term beetle outbreaks.

Alternative B would reduce the existing MPB hazard within the project area. To achieve a lower MPB hazard, most of the project area would have to consist of grass/forb, seedling or open sapling/pole size stands or have some sort of silvicultural treatment implemented to reduce stocking levels to less than 74 square feet of basal area per acre (Negron and Popp, 2003) Stands with a structural stage of 1, 2, 3A, as well as thinned stands, are examples of stands that have the lowest MPB hazard. The hazard would remain low into the next two decades and possibly longer depending on site conditions. The lower MPB hazard is a function of reduced pine tree density and more trees in smaller size classes in structural stages 1, 2, and 3A.

Slash buildup from treatments, could encourage Ips beetle buildup and mortality in residual stands of pine. Past practices of lopping, scattering, and burning of slash piles within a year of treatment has reduced Ips infestation to less than a few trees per acre. Whole tree skidding, would largely reduce the amount of slash and need for additional fuel treatments to mitigate fire hazard reduction, would also reduce the probability of insect infestations. Scattering slash facilitates the rapid drying of fuels, which reduces conditions favorable for Ips buildup. Other insects and diseases affecting both pine and other species of trees in the project area that are present are having minimal impact on the area and would probably continue to have a low impact under this alternative.

The disease of concern is dwarf mistletoe, which is a parasitic plant and is the most widespread and damaging disease agent in lodgepole, ponderosa, and limber pine throughout their ranges.
Treatments would be designed to favor removal of dwarf mistletoe infested trees and to prevent future regeneration from becoming infested.

**Stand Structure:**
Stand structure of lodgepole pine stands within the project area generally would be even-aged with the majority of the trees in the stands having an age within a range of 20 years of one another. Most of the pine is either intermediate, or co-dominant. After treatment, a new age class would be created where patch-cuts and group selections occur, making lodgepole pine across the landscape less homogeneous. Stand structure of ponderosa pine stands within the project area are generally uneven-aged with a mix of Douglas-fir, limber pine, and Rocky Mountain juniper. After treatment there would be a continued mix of species and age classes, however density would be lowered allowing remaining trees to be more vigorous and resistant to disturbance.

Within the project area stand structure generally would change from a more closed canopy structure to an open canopy structure. Changes in stand structure is intended to reduce MPB hazard, increase acres of younger structural stages, and to accomplish fire hazard reduction over the landscape within the wildland-urban interface (WUI).

**Age Class Distribution:**
Age class distribution would improve in this alternative, by favoring more mature stands.

**Stocking Levels:**
This alternative was designed to reduce MPB hazard and also fire hazard within large portions of the project area by increasing the spacing between trees. Fire managers have determined lower basal areas and associated reduced bulk density of crown fuels reduce the potential for catastrophic wildfires. The effect would be an increase in the quality of the timber through the removal of damaged, diseased, and poorly formed trees there would also be a resultant increase in individual tree growth by releasing the remaining trees from competition for light, water and nutrients. Trees would develop larger diameters due to a reduction of competition, which concentrates the stand growth on fewer stems. This alternative would contribute to the Forest Plan goal using acceptable silvicultural systems. This alternative would also provide adequately stocked pine stands for future management.

**Plant Species Composition:**
The amount of quaking aspen and meadow acreage would increase in this alternative. The extent and effects are described in the meadow and quaking aspen restoration sections previously discussed above. Opening of the stands would allow other grasses and forbs to become established in the understory. Pine regeneration in the understory after harvest would become abundant and may be a limiting factor in their establishment. Understory species establishment and diversity would be much greater than Alternative A because mechanical treatments and prescribed burning would limit pine regeneration and encourage grass, shrub and forbs establishment.
**Old Growth**

There are currently 289 acres within the project area identified as old growth or potential old growth. In addition, by leaving and creating 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.

Of the 289 acres Old Growth Stands are identified by cover type. Stands indicated as FOR and SMS are open areas with mature pine:

**Table 24 – Inventoried Old Growth**

<table>
<thead>
<tr>
<th>Cover Type</th>
<th>Acres</th>
<th>Veg. Treatment Acres</th>
<th>Prescribed Burn Acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>FOR – Forbs</td>
<td>164</td>
<td>92</td>
<td>106</td>
</tr>
<tr>
<td>SMS - Shrubs</td>
<td>21</td>
<td>0</td>
<td>21</td>
</tr>
<tr>
<td>TLP – Lodgepole Pine</td>
<td>82</td>
<td>37</td>
<td>0</td>
</tr>
<tr>
<td>TPP – Ponderosa Pine</td>
<td>151</td>
<td>56</td>
<td>25</td>
</tr>
</tbody>
</table>

Acres of Old Growth Proposed for treatment would be designed to enhance Old Growth Characteristics and under the case of Prescribed Broadcast Burns, protecting Old Growth trees. Lodgepole pine Old Growth would not be treated in Management area 3.5 – Forested Flora and Fauna Areas (Standard 1, Page 359) unless infested with MPB where Old Growth character has been compromised.

**Regeneration:**

The natural regeneration of pine and other native species of trees within the project should be good with the treatments in this alternative. Whole tree skidding would have the effect of site preparation by scarification of the forest floor, which favors regeneration establishment and has a positive effect in discouraging competition from grasses and forbs during seed germination and early regeneration establishment. This abundance of regeneration would, however, create dense sapling-sized pine over the next 20 to 40 years, which would necessitate non-commercial thinning in the future and pose an increased fire hazard as these pine become ladder fuels. Where prescribed burning occurs, regeneration would be reduced due to the rapid establishment of competitive grasses and forbs.

**Cumulative Effects**

**Past Activities and Their Effects on Silviculture/Timber**

Past activities are discussed Alternative A above. Cumulative effects of past treatments and treatments proposed in this alternative generally would be positive. Thinning of stands created with regeneration harvests would bring those stands into desired condition. Fire hazard reduction and MPB hazard that was lowered with past treatments would be maintained where treatment are implemented. Plant species diversity was increased with past treatments and would be further increased in these alternatives where treatment is implemented.
Present Activities and Effects on Silviculture/Timber
Present activities are minimal and their effects are listed in Alternative A above. Alternatives B and treatments would have a minimal additional effect to those discussed under direct and indirect effects for these alternatives.

Proposed and/or Reasonably Foreseeable Activities and Their Effects on Silviculture/Timber
Anticipated future silviculture activities, not connected to this analysis, that would occur within the area are as follows:
Future silvicultural activities would be minimal and their effects are listed under in Alternative A above. Alternatives B and treatments would have a minimal cumulative effect over those discussed under direct and indirect effects for these alternatives.

Activities that have a good probability of occurring on land within the Project area other than National Forest System Lands are as follows:
Silvicultural activities on other than National Forest System lands would be minimal and their effects are discussed in Alternative A above. Alternative B treatments would have a minimal cumulative effect over those discussed under direct and indirect effects for this alternative. Treatments on private land for fire hazard reduction would contribute to both a reduction of hazard from wildfire and mountain pine beetle.

Wildlife

Section 7 of the Endangered Species Act of 1973, as amended, requires federal agencies to "ensure" that actions authorized, funded, or carried out by them are not likely to jeopardize the continued existence of Proposed, Threatened, or Endangered, species, or result in the destruction or adverse modification of their critical habitats. In addition, the Forest Service has established direction in Forest Service Manual 2670 to guide habitat management for Proposed, Threatened, Endangered, and Sensitive species (PTES). This process ensures that PTES species receive full consideration in the decision-making process. The direction establishes the process, objectives, and standards for conducting a "Biological Evaluation". A Region 2 Manual Supplement 2600-2007-1 provides additional direction for conducting the analysis required in BEs.

This section discloses the likely effects of the alternatives to federally listed species, Forest Service sensitive species, management indicator species (MIS), and other species or habitats, for example old growth and effective habitat, pertinent to this project (USDA Forest Service, 1997). A summary of the analysis for wildlife species is presented below. The complete Glen Haven Fuels Reduction Wildlife Specialist Report is incorporated by reference and is part of the project record available at the Canyon Lakes Ranger District office.

A total of 21 terrestrial species were evaluated to determine if the species or their habitat is present within the project area: one federally threatened or endangered species; 12 Forest Service sensitive species; and 8 management indicator species (including two MIS species that also are Forest Service sensitive and are not duplicated in the above total). These species were carried forward for analysis, and the effects of the no action and proposed action alternatives for each species are addressed.
Table 25- Federally-listed wildlife species and Forest Service management indicator and sensitive species included in project analysis.

<table>
<thead>
<tr>
<th>Threatened/Endangered Species</th>
<th>Management Indicator Species</th>
<th>Sensitive Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preble’s meadow jumping mouse</td>
<td>Elk, Mule deer, Golden-crowned kinglet, Hairy woodpecker, Mountain bluebird, Pygmy Nuthatch, Warbling vireo, Wilson’s warbler, Boreal toad</td>
<td>American marten, Fringed myotis, Hoary bat, Townsend’s big-eared bat, Bald eagle, Flammulated owl, Lewis’ woodpecker, Northern goshawk, Olive-sided flycatcher, Boreal toad, Northern leopard frog, Wood frog, Hudsonian emerald</td>
</tr>
</tbody>
</table>

**All Species Discussion – No Action**

In the course of analysis, it became apparent that No Action effects for all species would be similar. In an attempt to minimize repetition, the effects of the No Action alternative for all Species other than TEP are found below. TEP species will have separate individual discussions.

**Direct, Indirect, and Cumulative Effects of No Action**

The No Action Alternative for project level activities are defined as, “no human-related management activities will occur within the proposed units.” Under this alternative, bark beetles will continue to infest mature pine stands throughout the Project Area. A wildfire may impact habitat within the project area but the scale and intensity of wildfires are unpredictable and outcomes are uncertain. If no action is taken, all species would likely continue to utilize the habitat available. Certain changes to species density and diversity may change with the advance of the infestation. For instance, as trees die from the beetle more woodpeckers may be attracted to the area but species that are cone dependent such as red squirrels and pygmy nuthatches may begin to abandon large areas of dead trees. However, it has been noted that many cone dependent species can survive on stored seeds and the seed remaining in cones on dead/burned trees. Both species have also been known to forage under bark for insects. This adaptability may help bridge the gap between fire/insect outbreaks and regeneration. Species such as elk and deer may continue to use areas of dead trees for thermal and hiding cover but may need to travel further to find suitable forage until the area begins to regenerate. New tree regeneration and stand development post infestation or wildfire will depend upon stand history, soils, topography, slope, aspect, elevation, weather, extent of the infestation/fire and other natural features. Therefore, because wildfires and insect infestations are stochastic and unpredictable in intensity and the Proposed Action is not intended to protect or improve habitat from these stochastic events, there will be no direct, indirect or cumulative effects as a result of No Action.

**Determination**

Because severe wildfires and insect infestations are stochastic and unpredictable in intensity, No Action may or may not change the amount of habitat altered by these natural processes and effects cannot be predicted with accuracy. Therefore, doing no action will maintain current and future habitat conditions as they relate to current existing conditions.
No Action Determination for sensitive species
Because the level of human use would not change, and current impacts to individual animals would continue, a determination of *No Impact* is made for all sensitive species.

No Action Determination for MIS
Because the level of human use would not change, and current impacts to individual animals would continue, a determination of neutral influence for all MIS species and their habitats is made.

All Species Discussion – Proposed Action Roads Activities

In the course of analysis, it became apparent that impacts from the Roads Actions described below would be similar to all species. In an attempt to minimize repetition, the effects of the Proposed Roads Activities for all Species other than TEP are found below. TEP species will have separate individual discussions.

The construction of these types of improvements and of temporary roads is likely to impact wildlife and their habitat by removal of vegetation and through increased sediment runoff. These new roads and road improvements are also likely to become vectors for increased human use and noxious weeds. However, with obliteration of these improvements in the proposed action, the effects would be temporary.

Direct, Indirect and Cumulative Impacts from Proposed Action Roads Activities
Over the long term, the closing and re-vegetation of temporary roads and the other roads identified above may help improve wildlife habitat in this area by reducing the amount of human traffic. However, once social use on a temporary road or trail is established, it has been shown to be very difficult or impossible to stop. There is currently an extensive network of social trails throughout the Project Area that were created utilizing old temporary road and skid trails from the previous harvest.

Determination for sensitive species for Proposed Action Roads Activities
Because the actions could increase impacts from and the number of social trails in the Project Area, a determination of may impact individuals but is not likely to lead to federal listing is made for all sensitive species.

Determination for MIS for Proposed Action Roads Activities
Because roads actions are likely to result in a loss of effective habitat temporarily, and increase human presence in the project area, a determination of negative influence for all MIS species and their habitats is made for roads activities. However, with obliteration of temporary roads and unauthorized roads (to be used for fuel treatment activities), as shown in the proposed action, this determination would be: may impact individuals for all MIS species.

Threatened and Endangered Species

Preble’s Meadow Jumping Mouse  *(Zapus hudsonius preblei)*
**Status:** Federally listed - Threatened

**Rationale for inclusion in analysis:** The Preble’s Meadow Jumping Mouse was selected for further analysis based on its status (Threatened) and the presence of potential habitat in the Project Area.

**Direct, Indirect, and Cumulative Effects of No Action:**
No direct, indirect or cumulative effects are expected from No Action. A severe wildfire may burn through riparian areas increasing potential for direct/indirect mortality and degradation of water quality. Wildfires however, are uncertain and unpredictable and may also create new Preble’s habitat by increasing openings and grassy habitat along creeks that are now dominated by conifers.

**Determination of No Action:**
Because severe wildfires are stochastic and unpredictable in intensity and the Proposed Action is not intended to protect or improve Preble’s habitat the effects of not treating the proposed units as a result of No Action will have **no effect** to the Preble’s Meadow Jumping Mouse.

**Direct, Indirect, and Cumulative Effects of Proposed Action**
There are no known Preble’s Meadow Jumping Mice (Preble’s) within or adjacent to any treatment units. Fuels reduction activities should not reduce habitat suitability in or near any streams that may have potential habitat. Gross reservoir and the three drainages that feed into it are considered at or above the elevational limit for the Preble’s. In addition, of the three drainages, only Winiger Gulch supports the appropriate plant communities suitable for Preble’s habitat. However, due to the high elevation and the fact that Gross reservoir blocks immigration of Preble’s from below the reservoir to Winiger Gulch above the reservoir it is the opinion of the FWS that any Preble’s populations that may have existed in Winiger Gulch have likely been extirpated since the building of Gross Reservoir. It is also the opinion of the FWS that there is no sustainable population of Preble’s above Gross Reservoir (Linner 2006).

Indirectly, treatment activities such as timber harvest and road improvements may affect Preble’s by increasing sediment runoff that could lower stream quality and/or bury streamside vegetation above the reservoir. However, established erosion control practices and the application of BMP’s, road improvements, and protection of riparian areas during project implementation should maintain existing stream water quality and any potential habitat.

**Determination for the Proposed Action:**
Because it has been determined that there is not likely be any existing or future populations of the Preble’s Meadow Jumping Mouse above the Gross Reservoir Dam, the Forsythe project should have **no effect** to the Preble’s Meadow Jumping Mouse. The FWS concurred with this conclusion via phone conversation between Deanna Williams and Leslie Ellwood on February 27, 2012. There is no need for further consultation.

**Forest Service Sensitive Species**

**American marten** (*Martes americana*)
Status: Forest Service Sensitive

Rationale for Inclusion: The American marten was selected for further analysis based on its status (Sensitive) and the presence of potential habitat within the Project Area.

Impacts of No Action
See comprehensive discussion of No Action for all species.

Impacts of the Proposed Action
Direct impacts to Marten may occur if trees are cut while occupied. An increase in heavy equipment and traffic may also lead to direct impacts from vehicle strikes. Indirect effects may occur from the rearrangement of fuels from the canopy to the ground. In general, Marten avoid habitats with less than 40% canopy cover (Ruggiero et al. 1994) and with more than 25% openings (Hargis et al. 1999) and it is unknown how chipping and mastication will impact their hunting strategies and consequently their use of an area in the future. Additionally, the reduction of dense forest may reduce the amount of security cover available during travel, or cause displacement from occupied territories. Hargis et al. (1999) discuss the overall influence of fragmentation on American Martens. One of the primary conclusions of this paper is that progressive cutting is the most preferred forest management method to maintain Marten on a landscape. It is discussed that narrow corridors (less than 100 meters) are not utilized by Marten and that high amounts of large down woody debris remaining after harvest is one of the largest predictive factors of Marten’s use of an open area. Additionally, Franklin and Forman (1987) had also described the benefits to clustering cuts or doing one large progressive cut. Both papers concluded that retention of large undisturbed stands was more important than dispersing the effects of smaller cuts across the landscape. The Project Area landscape is also already heavily fragmented by urban development. Should Marten currently occur in the Project Area, activities associated with growth of surrounding communities would likely have the most cumulative impacts. This project would contribute to those cumulative impacts on a short-term basis and over an insignificant part of their range.

Determination for the Proposed Action:
Because fuels reduction activities would occur within Marten habitat, and there would be an increase in human activity and vehicle traffic the Forsythe project May impact individuals, but since the Project Area is an insignificant portion of their overall range, the Forsythe project is not likely to result in a loss of viability within the planning area, nor cause a trend towards federal listing.

Bald eagle (Haliaeetus leucocephalus)

Status: Forest Service Sensitive, Federally listed - Recovery

Rationale for inclusion in analysis: The bald eagle was selected for further analysis based on its status and the potential for habitat in the Project Area around Gross Reservoir.

Impacts of No Action
See comprehensive discussion of No Action for all species.
Direct, Indirect and Cumulative Effects of the Proposed Action
There are no known bald eagles nesting, roosting or foraging within any treatment units. Fuels reduction activities will not reduce habitat suitability in or near Gross Reservoir which may be used by bald eagles for incidental foraging and roosting. Activities, such as timber harvest, could indirectly affect bald eagle prey base by temporarily introducing high sediment concentrations into streams and rivers. However, the application of project design should effectively mitigate any potential effects to prey species for bald eagles. The application of Project Design, road improvements, and protection of riparian areas during project implementation would ensure the maintenance of fish populations for the bald eagle prey base downstream from any treatment units. The watershed analysis for the Forsythe project states that all watersheds and sub-watersheds would remain under the threshold of concern after project implementation and that water quality would not be impaired. Cumulative effects to bald eagles in Boulder County are many, including development of outstanding water rights (effects to foraging habitat), expansion of transmission and distribution lines (collision and electrocution hazard), and increasing recreational use near nests and winter habitat (disturbance). This project would not contribute to those effects.

Determination for the Proposed Action:
Because bald eagles do not occur within or near any treatment units, nor do any treatment units contain suitable nesting habitat, and because mitigation measures preclude impacts to water resources that may affect occupied downstream bald eagle habitat, fuels reduction treatments for the Forsythe project area should have no effect on bald eagles.

Boreal toad (*Bufo boreas boreas*)

**Status:** Forest Service Sensitive, Forest Plan MIS (Montane riparian and wetlands)

**Rationale for inclusion in analysis:** The boreal toad was selected for further analysis based on its status (Sensitive and MIS) and the variety of habitats it occupies (breeding ponds, summer ranges, and over-winter terrestrial habitats).

**Impacts of No Action**
See comprehensive discussion for No Action for all species.

**Direct, Indirect, and Cumulative Effects of the Proposed Action**
Historical records and 2010 field surveys indicate that boreal toads do not occur in or adjacent to any of the treatment units. Project Design are consistent with Forest Plan standards and guidelines to protect and improve the condition of riparian areas and wetlands; and project mitigation precludes any mechanical activities within 100 feet of any wetland/riparian area. However, because boreal toads (especially breeding females) utilize uplands for most of the year, project activities may crush or kill toads as machinery or increased human traffic moves across the landscape. Indirectly, habitat may be impacted by the fragmentation and creation of edge habitat adjacent to stream corridors which may increase light and wind penetration causing an overall drying effect and reducing habitat quality. However, many insects and small mammals are known to respond positively to openings which may increase the available prey source for toads. Should boreal toads currently occur in the Project Area, activities associated with the growth and development of surrounding communities would likely have the most cumulative
impacts to boreal toad habitat as Project treatments buffer critical breeding habitat. In addition, this project proposes to leave higher levels of large dead and down woody debris which contributes a critical component of upland habitat (cool shady micro-sites) and winter refugia.

**Determination for the Proposed Action:**
Because an increase in heavy equipment, vehicle traffic and human activity may crush or kill individual toads using upland habitat the Forsythe project may impact individuals, but since boreal toads are not known to occur in the Project Area, and because any potential breeding habitat is buffered from treatment units, the Forsythe project is not likely to result in a loss of viability within the planning area, nor cause a trend towards federal listing for boreal toads. This determination is based on all suitable breeding habitats being adequately buffered and maintained.

**As a Management Indicator Species:**
Boreal toads are both a sensitive species and an MIS. Available information about MIS populations and trends was considered for this project, but monitoring and evaluation is carried out at broader scales to address populations across the entire Forest and Grassland and does not consider project level impacts. When taken in consideration with other cumulative effects to the boreal toad and its habitat on the ARNF, the Forsythe project is not expected to change habitat trends or population trends for the boreal toad on the ARNF.

**Flammulated owl (Otus flammeolus)**

**Status: Forest Service Sensitive**
Rationale for inclusion in analysis: The flammulated owl was selected for further analysis based on its status (Sensitive) and the presence of habitat within the project area. Field surveys in 2010 and 2011 confirmed the presence of at least 3 territories within the Project Area.

**Impacts of No Action**
See comprehensive discussion of No Action for all species.

**Direct, Indirect and Cumulative Impacts of the Proposed Action**
Direct impacts may occur if a nest or roost tree is removed while occupied. Although snags and mature trees are not targeted for removal, some may be removed if they pose a hazard to workers or if they have infested with bark beetles during harvest. This loss of large mature snags could greatly reduce the amount of suitable flammulated owl habitat. It is unknown if snags will be able to withstand windthrow after surrounding trees have been removed. However, it is expected that this criteria will help maintain current habitat suitability and provide for future habitat components when the stands begin to regenerate. In addition, chipping or other slash would increase. This increase of woody material may benefit some insect prey species, but can become thick and may increase surface fire intensities and/or suppress understory regeneration. However, the scope and scale of the Forsythe project contains a small portion of mature ponderosa pine relative to the rest of the owls range.

Since owls currently occur in the Project Area, the loss of habitat and other activities associated with growth and development of surrounding communities would likely have the most...
cumulative impacts to the birds. Additionally, because fuels treatments most frequently target the Ponderosa pine type and the WUI interface the cumulative effects of all fuels treatments and removal of beetle killed snags across the owl’s range is likely to add to the impacts of increased development. So it is possible that without appropriate Project Design the cumulative impacts of the Forsythe project may disproportionately affect the Flammulated owl. The Project Design of this project are intended to maintain all existing appropriate habitat components on the landscape such as suitable cavity trees, and large diameter open canopy trees used for roosting and foraging.

**Determination for Proposed Action**
Because the Forsythe project will introduce equipment, roads and traffic that may disturb or strike Flammulated owls and because individual habitat components important to the owls may be removed due to worker safety the project *May* adversely impact individuals, but due to extensive Project Design intended to protect existing owl territories and provide for future owl territories the project is not likely to result in a loss of viability within the planning area, nor cause a trend towards federal listing for the Flammulated owl or its habitat.

**Fringed myotis (Myotis thysanodes)**

**Status: Forest Service Sensitive**

**Rationale for inclusion in analysis:** The fringed myotis was selected for further analysis based on its status (Sensitive) and the presence of potential habitat in the Project Area.

**Impacts of No Action**
See comprehensive discussion of No Action for all species.

**Direct, Indirect and Cumulative Impacts of the Proposed Action**
Direct impacts may occur if an occupied roost tree is removed. While snags and mature trees are not targeted for removal, they may be felled for safety reasons or if the tree is currently infested with bark beetles at the time of harvest. This loss of large snags with peeling bark could greatly reduce the amount of suitable habitat on the landscape. It is unknown if remaining snags will be able to withstand windthrow after surrounding trees have been removed.

Indirect impacts of treatments could include removal of future roost trees, a reduction in stand density and canopy closure (leading to a long-term increase in insect abundance, but a short-term decrease in understory plants that may decrease insect abundance) and the potential for bats to be disturbed or displaced by project activities. Disturbance to bats during the day makes them extremely vulnerable to predation and exhaustion. It is expected that the use of heavy equipment, chippers, chainsaws and other related equipment may disturb roosting bats for several years during project implementation. Prescribed burning during spring and fall may also disturb hibernating bats if smoke from the burn penetrates the hibernacula. Prescribed burning is only expected to occur over a few days and any sign of disturbance to hibernacula would shut down burning in that area until a Wildlife Biologist can be consulted. The amount of edge habitat is expected to increase with harvest and with skid trails and temporary roads, which often benefits hunting bats. In addition, chips or other slash would increase. This increase of woody
material to the forest floor may benefit some insect prey species, but slash/chips can become thick and may increase surface fire intensities and/or suppress understory regeneration.

Should Fringed myotis currently occur in the Project Area, activities associated with growth and development of surrounding communities would likely have the most cumulative impacts as dead trees are generally not tolerated adjacent to or on developed properties. Additionally, because fuels treatments most frequently target the ponderosa pine type and the WUI interface the cumulative effects of all fuels treatments and removal of beetle killed snags across the bat’s range is likely to add to the impacts of increased development. So it is possible that the cumulative effects of the Forsythe project may disproportionately impact the Fringed myotis.

Because bat roosts under peeling bark are relatively short lived compared to cavities excavated in snags by birds the cumulative effects of all fuels treatments and removal of beetle killed snags across the region is likely to reduce a high portion of desired habitat for the bats. However, the scope and scale of the Forsythe project contains a small portion of mature ponderosa pine relative to the amount of lodgepole pine available. However, due to the beetle infestation, there may be a higher proportion of recently killed trees available for roosting throughout the project area. Leaving snags during harvest may help provide a variety of snag decay classes across the landscape as the stands begin to regenerate, reducing the impacts to the bats over the long term.

**Determination for the Proposed Action**
Because of heavy equipment disturbance to roosting trees during daylight hours and the removal of many potential roost trees due to beetle infestation the Forsythe project may impact individuals, but with the increase amount of recently killed snags available on the landscape and Project Design intended to provide a wide range of snag decay classes into the future, the project is not likely to result in a loss of viability within the planning area, nor cause a trend towards federal listing.

**Hoary bat (Lasiurus cinereus)**

**Status: Forest Service Sensitive**

**Rationale for inclusion in analysis:** The Hoary bat was selected for further analysis based on its status (Sensitive) and the presence of potential habitat in the Project Area.

**Impacts of No Action**
See comprehensive discussion of No Action for all species.

**Direct, Indirect and Cumulative Impacts of the Proposed Action**
Direct impacts may occur if an occupied roost tree is removed. While snags and mature trees are not targeted for removal, they may be felled for safety reasons or if the tree is currently infested with bark beetles at the time of harvest. This loss of large snags with peeling bark could greatly reduce the amount of suitable habitat on the landscape. It is unknown if remaining snags will be able to withstand windthrow after surrounding trees have been removed.

Indirect impacts of treatments could include removal of future roost trees, a reduction in stand density and canopy closure (leading to a long-term increase in insect abundance, but a short-term decrease in understory plants that may decrease insect abundance) and the potential for bats to be
disturbed or displaced by project activities. Disturbance to bats during the day makes them extremely vulnerable to predation and exhaustion. It is expected that the use of heavy equipment, chippers, chainsaws and other related equipment may disturb roosting bats for several years during project implementation. The amount of edge habitat is expected to increase with harvest and with skid trails and temporary roads, which often benefits hunting bats. In addition, chips or other slash would increase. This increase of woody material to the forest floor may benefit some insect prey species, but slash/chips can become thick and may increase surface fire intensities and/or suppress understory regeneration.

Should Hoary bats currently occur in the Project Area, activities associated with growth and development of surrounding communities would likely have the most cumulative impacts as dead trees are generally not tolerated adjacent to or on developed properties. However, Hoary bats have been observed foraging within the light of street lamps or other outdoor lighting. Because Hoary bats are more generalist in their habitat preference than Fringed myotis, it is unlikely that removal of snags within the Forsythe or other fuels reduction projects would disproportionately impact roost availability across the bats’ range with the ongoing beetle infestation providing a somewhat continuous source of new snags across the landscape. Project Design intended to maintain large amounts of wildlife suitable snags both within and outside of units may not reduce the overall impact to the Hoary bat in the short term as bats have not been found to use snags isolated in clearcuts. But leaving snags during harvest may help provide a variety of snag decay classes across the landscape as the stands begin to regenerate, reducing the impacts to the bats over the long term. In addition, removing dense understory and providing more light into stands often increases insect abundance and may help provide new patches of foraging habitat.

**Determination for the Proposed Action**

Because of heavy equipment disturbance to roosting trees during daylight hours and the removal of potential roost trees due to beetle infestation the Forsythe project May impact individuals, but with the increase amount of recently killed snags available on the landscape and Project Design intended to provide a wide range of snag decay classes into the future, the project is not likely to result in a loss of viability within the planning area, nor cause a trend towards federal listing.

**Hudsonian emerald dragonfly (Somatochlora hudsonica)**

**Status: Forest Service Sensitive**

**Rationale for inclusion in analysis:** The Hudsonian emerald was selected for further analysis based on its status (Sensitive), the presence of known habitat near the Project Area, and the presence of potential habitat within the project area.

**Impacts of No Action**

See comprehensive discussion of No Action for all species.

**Direct, Indirect and Cumulative Impacts of the Proposed Action**

Historical records indicate that the Hudsonian emerald does not occur in or adjacent to any of the treatment units and is unlikely due to the lower elevation and higher summer temperatures of project units. Due to lack of local surveys habitat could exist and may experience indirect
impacts from project activities such as increased sedimentation from skid trails and roads. Direct impacts are unlikely as Project Design are consistent with Forest Plan standards and guidelines to protect and improve the condition of riparian areas and wetlands; and project mitigation precludes any mechanical activities within 100 feet of any wetland/riparian area. However, because *H. emerald* adults are sometimes found in the uplands adjacent to wetlands, project activities may reduce perching and hunting habitat. Indirectly, habitat may be impacted by the fragmentation and creation of edge habitat adjacent to stream corridors which may increase light and wind penetration causing an overall drying effect. Many insects are known to respond positively to openings which may increase the available prey source. Should *H. emerald* occur in the Project Area, activities associated with the growth and development of surrounding communities would likely have the most cumulative impacts as most fuels treatments buffer breeding habitat. Project activities are not expected to contribute to overall cumulative impacts to *H. emerald* habitat.

**Determination for the Proposed Action**
Because of the possibility of increased sedimentation of streams and wetlands due to skid trails and temporary roads the Forsythe project may impact individuals, but since Because *H. emerlads* are not likely to occur in the project units, and because treatment units buffer any potential breeding habitat the project is not likely to result in a loss of viability within the planning area, nor cause a trend towards federal listing. This determination is based on all suitable breeding habitats being adequately buffered and maintained.

**Lewis’ woodpecker** (*Melanerpes lewis*)

**Status:** Forest Service Sensitive

**Rationale for inclusion in analysis:** The Lewis’ woodpecker was selected for further analysis based on its status (Sensitive) and its likely use of open habitats and snags present in the Project Area.

**Impacts of No Action**
See comprehensive discussion of No Action for all species.

**Direct, Indirect and Cumulative Impacts of the Proposed Action**
Direct impacts may occur if a nest tree is removed while occupied. Although snags and mature trees are not targeted for removal, some may be removed if they pose a hazard to workers or if they have succumbed to the bark beetle infestation during harvest. This loss of large mature snags could greatly reduce the amount of suitable Lewis’ woodpecker habitat on the landscape. Project Design of leaving 3 snags per acre intended to lessen the impact of this habitat loss. Unfortunately, it is unknown if these snags will be able to withstand windthrow after surrounding trees have been removed. Harvest activities could indirectly impact the woodpecker’s habitat structure.

Indirectly, the removal of large trees and snags would decrease suitability and use of the area by Lewis’ woodpeckers. However, clearing dense understories while maintaining large trees and snags on the landscapes may help attract Lewis’ to the area. Fragmentation, woody debris and chipping slash would also increase. The increase of woody material may benefit some prey
species, but can become thick and may increase surface fire intensities and suppress understory regeneration which would decrease habitat suitability in the event of a wildfire. Cutting activities may also interfere or displace foraging activities due to increased traffic and human presence.

Should woodpeckers currently occur in the Project Area, activities associated with growth and development of surrounding communities would likely have the most cumulative impacts to the birds. Dead trees are generally not tolerated on developed properties. In addition, Lewis’ woodpeckers have been known to be excluded from an area by competition from non-native cavity nesters such as European starlings which increase with human development. The cumulative effects of all fuels treatments across the region are likely to reduce desired habitat for the Lewis’ woodpecker. The Forsythe project is designed to help maintain large trees and snags that are critical components of this woodpecker’s habitat. It is intended that with these Project Design the project will not add to cumulative impacts from other fuels reduction projects and private land development. In addition, the thinning of small overstocked stands and the removal of understory in old growth ponderosa pine stands should benefit the woodpecker’s habitat within the Project area.

**Determination for the Proposed Action**
Because nesting trees may be felled while occupied and large trees and snags may be removed during project activities the Forsythe project may impact individuals, but because Project Design are intended to retain as much of these habitat components as possible and the project is designed to improve habitat at the local scale, the project is not likely to result in a loss of viability within the planning area, nor cause a trend towards federal listing.

**Northern goshawk** (*Accipiter gentilis*)

**Status:** Forest Service Sensitive

**Rationale for inclusion in analysis:** The Northern goshawk was selected for further analysis based on its status (Sensitive), its intolerance to disturbance, and the presence of habitat within the project area.

**Impacts of No Action**
See comprehensive discussion of No Action for all species.

**Direct, Indirect and Cumulative Effects of the Proposed Action**
Direct impacts may occur if a nest or roost tree is removed while occupied. All known territories have a LOP (March-September) unless approved for activities by the Wildlife Biologist. Known nest sites have a ¼ mile no treatment buffer to help maintain the preferred microclimate selected by the birds for nesting. Any new nests discovered at any time during treatment will also be buffered appropriately. However, buffering known or new nest sites may not completely reduce direct impacts if persistent disturbance during the breeding season to a nearby but unobserved nest. Direct impacts could occur at an unobserved nest if disturbance during the breeding season causes nest abandonment and mortality of young birds or eggs. Frequent disturbance within a few hundred meters of the nest can cause the parents to leave the nest and alarm call at intruders. This kind of disturbance has been documented to reduce incubation of young, reduce prey
deliveries and attract predators to the area. All of which can result in the fatality of one or all nestlings.

Fuels treatment activities could indirectly impact goshawk habitat structure. Edges of larger openings can often be used by hunting goshawks if they support prey species. Given that the units slated to be patch cut and potentially clear-cut (through sanitation and salvage activities) are currently mostly supporting red squirrels, it is assumed that the cutting would cause a decrease in available prey (squirrels). It is unclear how long it will take alternative prey to reoccupy the site and probably depends on the ability of the site to regenerate, and the amounts of snags, large woody debris and chipping slash left behind. High densities of chipping slash could suppress understory regeneration, further delaying habitat recovery for goshawk prey species such as rabbits and grouse. Project activities may interfere or displace foraging activities due to increased traffic and human presence. The increase in edge and open habitat as a result of proposed treatments could also favor goshawk predators such as great-horned owls and red-tailed hawks. Overall, if nesting habitat is maintained cumulative effects of fuels treatments should benefit the Northern goshawk in the long term by maintaining and enhancing open habitat and encouraging the next generation of conifers to regenerate. It is anticipated that the clear-cut areas will produce young trees with seed cones faster than beetle killed stands left untreated. This heterogeneous landscape would continue to support a diversity of goshawk prey.

**Determination for the Proposed Action**

Because there will be habitat disturbance and a loss of habitat for existing goshawk prey the project may impact individuals, but because Project Design is intended to reduce impacts to breeding birds, maintain current nesting habitat and provide a better diversity of foraging habitat in the long term, the project is not likely to result in a loss of viability within the planning area, nor cause a trend towards federal listing.

**Olive-sided flycatcher (Contopus cooperi)**

**Status:** Forest Service Sensitive

**Rationale for Inclusion in Analysis:** This species was selected for further analysis based on its status (Sensitive) and the presence of habitat and the species within the Project Area.

**Impacts of No Action**

See comprehensive discussion of No Action for all species.

**Direct, Indirect and Cumulative Effects of the Proposed Action**

Direct impacts may occur if an occupied nest tree is removed. Nest trees are often on the edges of clearings and can be prime targets for WUI removal. Increases in vehicle traffic and human activity could also directly impact birds from vehicle strikes or loss of nests due to abandonment. Fuels treatment activities could indirectly impact the birds’ habitat structure. Although large, older snags are not targeted for removal, some may be removed if they pose a hazard to workers or if necessary to reduce the risk fire directly adjacent to private land. If hunting/perching snags are removed from occupied habitat this could result in abandonment of the territory. However, if large, older snags are retained on the landscape adjacent to openings other project impacts such as thinning dense understory and enhancing openings and edge habitat may actually benefit the
Olive-sided flycatcher (OSFL). Fragmentation, woody debris and chipping slash would increase. The increase of woody material may benefit some insect prey species, but can become thick and could increase surface fire intensities or suppress understory regeneration. Increased fire intensities would likely cause abandonment of the territory following a wildfire, and suppression of understory grasses and shrubs would reduce insect prey and habitat suitability. Cutting activities may interfere or displace foraging activities due to increased traffic and human presence. Cutting activities could also impact habitat structure by reducing canopy cover adjacent to nesting trees thereby increasing sunlight and wind penetration into these protected areas. Project Design within the proposed action are intended to maintain the existing patches of suitable flycatcher habitat and also retain slightly higher amounts of large, old snags and large dead and down material. It is expected that these two criteria will help maintain current habitat suitability and provide for future habitat components when other stands begin to regenerate. It addition, the creation of edge and the retention of snags along that edge, should help improve flycatcher habitat as they prefer to hunt over openings from a snag perch.

Since flycatchers currently occur in the Project Area, activities associated with growth and development of surrounding communities would likely have the most cumulative impacts to the birds due to habitat reduction, fragmentation, and increased human disturbance. If current OSFL territories are maintained and Project Design are implemented that will help increase the amount of available habitat, the Forsythe project should not add negative cumulative effects to the OSFL or its habitat across its range.

**Determination for the Proposed Action**
Since Project Design is intended to maintain existing territories and promote additional suitable habitat the Forsythe project is not likely to result in a loss of viability within the planning area, nor cause a trend towards federal listing for the OSFL.

**Townsend’s big-eared bat (Corynorhinus townsendii)**

**Status:** Forest Service Sensitive  
**Rationale for inclusion in analysis:** Townsend’s big-eared bat was selected for further analysis based on its status (Sensitive) and the potential habitat in the Project Area; it is likely that these bats are present within the Project Area as there are known roost site sites adjacent to some units.

**Impacts of No Action**
See comprehensive discussion of No Action for all species.

**Impacts of Proposed Action**
Direct impacts may occur if an occupied roost tree is removed. While snags and mature trees are not targeted for removal, they may be felled for safety reasons or if the tree has succumbed to bark beetles. This loss of large mature snags could greatly reduce the amount of suitable roost trees on the landscape. It is unknown if remaining snags will be able to withstand windthrow after surrounding trees have been removed. Other direct impacts could include disturbance to winter or maternity roosts if smoke from prescribed fire or pile burning penetrates the roosts. Disturbance to bats while roosting or hibernating makes them extremely vulnerable to predation and exhaustion. The presence of smoke in hibernacula or maternity colonies may cause
Temporary abandonment of the roost, leading to starvation and abandonment of young (CBWG 2011).

Indirect impacts of treatments could include removal of future roost trees, a reduction in stand density and canopy closure (leading to a long-term increase in insect abundance, but a short-term decrease in plants that currently support insect abundance) and the potential for bats to be disturbed or displaced by project activities. Disturbance to bats during the day makes them extremely vulnerable to predation and exhaustion. It is expected that the use of heavy equipment, chippers, chainsaws and other related equipment may disturb roosting bats for several years during project implementation. The amount of edge habitat is expected to increase with harvest and with skid trails and temporary roads, which often benefits hunting bats. In addition, chips or other slash would increase. This increase of woody material to the forest floor may benefit some insect prey species, but slash/chips can become thick and may increase surface fire intensities or suppress understory regeneration. Increased fire intensities would likely cause abandonment of the area following a wildfire, and suppression of understory grasses and shrubs would reduce insect prey and habitat suitability. The amount of edge habitat is expected to increase which often benefits hunting bats.

Should Townsend’s big-eared bats occur in the Project Area, activities associated with growth and development of surrounding communities and the associated impacts to maternity colony caves is likely to have the most substantial impact to bats in this area. Because Townsend’s bats are general in their day roost selection, it is unlikely that removal of snags within the Forsythe or other fuels reduction projects would disproportionately impact roost availability across the bats’ range with the ongoing beetle infestation providing a somewhat continuous source of new snags across the landscape. However, snags or trees with peeling bark near or adjacent to riparian areas or open water would particularly benefit this species. Project Design intended to maintain large amounts of wildlife suitable snags both within and outside of units may not reduce the overall impact to the Townsend’s bat in the short term as bats have not been found to use snags isolated in clearcuts. But leaving snags during harvest may help provide a variety of snag decay classes across the landscape as the stands begin to regenerate, reducing the impacts to the bats over the long term. In addition, removing dense understory and providing more light into stands often increases insect abundance and may help provide new patches of foraging habitat. If smoke from prescribed fire causes bats to leave an occupied roost, this project may contribute to range-wide impacts due to these vulnerable and rare roost sites. All known roosts will be buffered and monitored on burn days to help ensure smoke does not penetrate the roost.

**Determination for the Proposed Action**

Because of heavy equipment disturbance to roosting trees during daylight hours, the potential for smoke to impact winter/maternity roosts and the removal of potential day roost trees the Forsythe project may impact individuals, but with the increase amount of recently killed snags available on the landscape and Project Design intended to protect known roosts and provide for a wide range of snag decay classes into the future, the project is not likely to result in a loss of viability within the planning area, nor cause a trend towards federal listing.
Northern leopard frog (*Rana pipiens*) and Wood frog (*Rana sylvatica*)

(Impacts to the Northern Leopard Frog and Wood Frog were combined due to their similarity in habitat and life history requirements.)

**Status:** Forest Service Sensitive

**Rationale for inclusion in analysis:** The northern leopard frog and the wood frog were selected for further analysis based on its status (Sensitive), the presence of potential habitat in the Project Area.

**Impacts of No Action**

See comprehensive discussion of No Action for all species.

**Direct, Indirect, and Cumulative Effects of the Proposed Action**

Historical records and 2010 surveys indicate that neither frog species occurs in any of the treatment units. However, suitable habitat directly adjacent to units was not surveyed due to private land boundaries. Project Design are consistent with Forest Plan standards and guidelines to protect and improve the condition of riparian areas and wetlands (e.g. protection from sedimentation etc.); and project mitigation precludes any mechanical activities within 100 feet of any wetland/riparian area. However, dispersing frogs may be crushed or killed as machinery and increased human traffic moves across the landscape. Indirectly, habitat may be impacted by the fragmentation and creation of edge habitat adjacent to stream corridors, which may increase light and wind penetration causing an overall drying effect. Many insects are known to respond positively to increased light from forest openings which may increase the available prey source. Should either of these frogs currently occur in the Project Area, activities associated with the growth and development of surrounding communities would likely have the most cumulative effects. These impacts could include the introduction of disease, which may be transported by humans as they visit wetlands and ponds; introduction of non-native species such as bullfrogs and bass; and altering structure of existing wetlands most commonly to deepen in order to introduce and maintain non-native species, or to drain for building sites or pastures; or for use as livestock ponds which can trample banks and destroy stream edge habitat. The Forsythe project is not likely to contribute to any of these impacts as most fuels treatments buffer wetland and other water bodies.

**Determination for the Proposed Action**

Because suitable habitat exists on the boundaries of some units there is the possibility that dispersing frogs may be crushed or killed due to the increase in vehicles and heavy equipment in the area; therefore the Forsythe project *May impact individuals*; however, since neither frog species is known to occur in the Project Area, and because treatment units buffer critical breeding habitat, the proposed action, *is not likely to result in a loss of viability within the planning area, nor cause a trend towards federal listing*. This determination is based on all suitable breeding habitats being adequately buffered and

**Management Indicator Species (MIS)**

**Elk** (*Cervus elaphus*)
**Status:** Forest Plan MIS (Young to Mature Forest and Openings)

**Rationale for inclusion in analysis:** Elk were selected for further analysis based on their status (MIS), known presence in the Project Area, and the versatility of the habitats they occupy.

**Influence of No Action**

See comprehensive discussion of No Action for all species.

**Influence of Proposed Action**

Direct impacts to elk would occur if elk are present when harvest is occurring. Elk are known to move away from harvest disturbance if it occurs for a long period of time or the extent of harvest. The Project Area includes Winter and Severe Winter concentration areas for elk. The area is also known for Summer habitat and migration corridor. Patch cuts in dense forest adjacent to open meadows, quaking aspen or other grassy areas may compromise the suitability of the area as winter habitat. LP 6 has been documented during surveys in 2011 as key winter thermal and hiding cover for elk that graze in the series of meadows surrounding and extending from Giggy Lake. As a mitigation measure to prevent severe impacts to the local elk population, the north side of LP 6 will be retained as is with no treatment to retain thermal and hiding cover properties key to elk use. Summer habitat in open ponderosa and quaking aspen should be improved and increased through the Proposed Action. The mechanical treatments of sanitation and removal, patchcuts, and thinning in Ponderosa Pine and quaking aspen restoration are all expected to improve forage conditions for elk since they would facilitate increased light and nutrients to the forest floor. This should result in increased forage for elk. Surveys of the Project Area in 2010 and 2011 indicated that past treatments within quaking aspen and ponderosa pine (approximately 5-10 years post treatment), have regenerated to grass with scattered conifer trees or quaking aspen and are being heavily and preferentially used by elk. Thomas et al. (1988) showed that the highest winter range forage and cover use occurs within 100 yards (91 meters) of edges. General, forage area use starts to decline about 200 feet from edge and declines rapidly at 400 to 600 feet from edge, especially with high human use. Project Design and mitigation measures are intended to maintain or enhance elk habitat and use of the Project Area.

**Estimation of influence for the proposed action**

Overall, a positive habitat influence is expected because of the forage increase expected as a result of all treatments proposed. No changes to forest-wide population trends are expected if Project Design and mitigation measures to protect thermal/hiding cover next to critical winter range are followed.

**Mule deer** (*Odocoileus hemionus*)

**Status:** Forest Plan MIS (Young to mature forest structural stages, openings)

**Rationale for inclusion in analysis:** Mule deer were selected for further analysis based on their status (MIS), known presence in the area, and the versatility of the habitats they occupy.

**Influence of No Action**

See comprehensive discussion of No Action for all species.
Influence of Proposed Action
The mechanical treatments of sanitation and removal, patch cuts, thinning and quaking aspen enhancement are all expected to improve forage conditions for deer since they would facilitate re-vegetation in openings created by the treatments. Hiding and thermal cover would be reduced within the units. Most deer are likely to leave the area when activities begin and are expected to return when browse begins to recover. Deer are generally less tolerant of large scale disturbance than elk, however this is a highly urban area and their tolerance for human activity may already be quite high. Unit surveys in 2010 and 2011 indicated that past treatments that have regenerated to grass and scattered conifer trees or quaking aspen are being heavily and preferentially used by deer, approximately 20 years post-treatment. However, if patches get too large and if corridors become subject to beetle kill and windthrow it is uncertain if deer would continue to use these areas due to a loss of hiding and thermal cover.

Estimation of influence for the proposed action
Overall, a positive habitat influence is expected because of the forage increase expected as a result of all treatments proposed. No changes forest-wide population trends are expected.

Golden-crowned kinglet (*Regulus satrapa*)

**Status:** Forest Plan MIS (MIC - Interior Forest)

**Rationale for inclusion in analysis:** The golden-crowned kinglet was selected for further analysis based on its status (MIS), its presence in drainages in the Project Area, and the presence of Interior Forest in the Project Area.

Influence of No Action
See comprehensive discussion of No Action for all species.

Influence of the Proposed Action
Spruce-fir, the primary habitat used by golden-crowned kinglets, is targeted for limited removal with intact islands of spruce-fir left within any unit that has this habitat type. Where mature forests (of any species) are involved with treatment, the stated project goal is to maintain and enhance mature/old-growth characteristics while removing co-dominant trees to reduce fire hazards. If mature/old-growth stands are beetle-killed at implementation, higher amounts of snags and downed woody debris will be left than normal to facilitate a faster return to old-growth conditions. The high amounts of forest edge habitat created as a result of this project would generally be detrimental to the kinglet due to the increased penetration of nest predators into an interior patch of spruce-fir and the drying and windthrow associated with small patches left within large open patches. However, this project area contains small pockets of suitable habitat and during songbird surveys; kinglets were found in almost every drainage with a spruce-fir component in the project area. Therefore, considering that mature forest and interior forest habitat is intended to be retained, this project may impact foraging habitat for the kinglet but should not influence primary breeding habitat.
**Estimation of influence for the proposed action**
Overall, a neutral habitat influence is expected because there is no primary habitat within units and when spruce-fir does occur within units, it will be left as intact as possible and therefore, No changes forest-wide population trends are expected.

**Hairy woodpecker** (*Picoides villosus*)

**Status:** Forest Plan MIS (MIC - Young to mature forest structural stage)
**Rationale for inclusion in analysis:** The hairy woodpecker was selected for further analysis based on its status (MIS) and the presence of the species and its habitat in the Project Area.

**Influence of No Action**
See comprehensive discussion of No Action on all species.

**Influence of Proposed Action**
The potential loss of both large and/or rotten snags for nesting and bark beetle infested snags for foraging could greatly reduce the amount of suitable woodpecker habitat on the landscape. Unfortunately, it is unknown if remaining snags will be able to withstand windthrow after surrounding trees have been removed. The cumulative effects of all fuels treatments across the region is likely to reduce a portion of desired habitat for the woodpecker by reducing the snags created by wildfire, and reducing standing snags infested with beetle larvae that are both critical to maintain woodpecker populations over the long term. Hairy woodpeckers may be displaced and/or breeding may completely stop during treatment activities.

**Estimation of influence for Proposed Action**
Overall, a negative habitat influence is expected due to the loss of beetle larvae and nesting snags, however no changes forest-wide population trends are expected due to the small scope of the Forsythe project and the large scale of the beetle infestation.

**Mountain bluebird** (*Sialia currucoides*)

**Status:** Forest Plan MIS (MIC - open openings within and adjacent to forests)
**Rationale for inclusion in analysis:** The mountain bluebird was selected for further analysis based on its status (MIS), presence, and habitat in the Project Area.

**Influence of No Action**
See comprehensive discussion for No Action for all species.

**Influence of Proposed Action**
Mountain bluebirds utilize openings and edges of forested habitats. The treatments proposed would create many larger openings and greater amounts of edge habitat. The loss of mature nesting snags within these treatment areas would be expected to be a loss to mountain bluebird breeding for several years, if they were removed. Unfortunately, it is unknown if remaining snags will be able to withstand windthrow after surrounding trees have been removed. The cumulative effects of all fuels treatments across the region is likely to reduce a portion of desired habitat for the bluebird by reducing the amount of snags created by wildfire, and reducing the...
amount of open meadows that are critical to maintain bluebird populations over the long term. However, the scope and scale of the loss of up to 5,318 acres for the Forsythe project is relatively small and is not designed to stop wildfire or beetle outbreaks. Mountain bluebirds may be displaced and/or breeding may completely stop and or eggs and young birds killed during treatment activities.

**Estimation of influence for Proposed Action**
Overall, a positive habitat influence is expected due to the increase of edge habitat and openings, however a short term decrease in forest-wide population trends are expected considering that suitable and available nest cavities are targeted for removal due to the hazard tree program on the ARNF in combination with large scale fuels reduction in ponderosa pine.

**Pygmy nuthatch** (*Sitta pygmaea*)

**Status:** Forest Plan MIS (MIC - Existing and potential old-growth forests)

**Rationale for Inclusion in Analysis:** The pygmy nuthatch was selected for further analysis based on its status (MIS) and the presence of the species and its habitat in the Project Area.

**Influence of No Action**
See comprehensive discussion of No Action for all species.

**Influence of Proposed Action**
Pygmy nuthatches may be displaced and/or breeding may completely stop and or eggs and young birds killed during treatment activities. The loss of both large and/or rotten snags for nesting and bark beetle infested snags for foraging could greatly reduce the amount of suitable nuthatch habitat on the landscape. Unfortunately, it is unknown if remaining snags will be able to withstand windthrow after surrounding trees have been removed. The cumulative effects of all fuels treatments across the region is likely to reduce a portion of desired habitat for the woodpecker by reducing the snags created by wildfire, and reducing standing snags infested with beetle larvae that are both critical to maintain nuthatch populations over the long term.

**Estimation of influence for Proposed Action**
Overall, a neutral habitat influence is expected due to the loss of potential cavity trees being offset by the beetle infestation and the higher amount of snags being left within units. However a short term decrease in forest-wide population trends are expected considering that suitable and available nest cavities are targeted for removal due to the hazard tree program on the ARNF in combination with large scale fuels reduction in ponderosa Pine and old growth habitat types.

**Warbling vireo** (*Vireo gilvus*)

**Status:** Forest Plan MIS (MIC - Quaking aspen communities)

**Rationale for Inclusion in Analysis:** The warbling vireo was selected for further analysis based on its status (MIS) and the presence of the species and its habitat in the Project Area.

**Influence of No Action**
See comprehensive discussion of No Action for all species.
Influence of Proposed Action
Warbling vireos may be displaced and/or breeding may completely stop and or eggs and young birds killed during treatment activities. The removal of conifers from within and around quaking aspen stands is expected to improve both nesting and foraging habitat by removing competing vegetation (conifers) and promoting increased growth of existing quaking aspen stands. In addition to promoting growth within the existing stands, treatments are expected to increase growth around the stands in order to expand the clones. Quaking aspen trees themselves are not proposed for treatments and all existing snags greater than 6 inches are expected to remain, although some may be lost if they are a danger to workers or due to incidental felling. Once operations are complete vireos are expected to utilize the area at or above previous levels. There is sufficient habitat in the area to support local populations while implementation is ongoing. All treatments proposed are intended to maintain mature quaking aspen (current breeding habitat) and encourage sprouting of new quaking aspen (future breeding and foraging). Cumulatively, the impacts of the bark beetle and fuels reduction treatments across the forest are anticipated to increase the amount of vireo habitat.

Estimation of influence for Proposed Action
Overall, a positive habitat influence is expected due to the anticipated increase in quaking aspen, however no changes forest-wide population trends are expected due to the small scope of quaking aspen being treated in the Forsythe project.

Wilson’s warbler  (*Wilsonia pusilla*)

**Status:** Forest Plan MIS (MIC - Montane riparian and wetlands)
**Rationale for Inclusion in Analysis:** Wilson’s warbler was selected for further analysis based on its status (MIS) and the presence of the species and its habitat in the Project Area.

Influence of No Action
See comprehensive discussion of No Action for all species.

Influence of Proposed Action
Wilson’s warbler habitat (riparian areas, willow) should not be mechanically treated. In addition, all streams and riparian areas would be buffered by at least 100 feet from mechanical equipment. Existing rules and regulations for wetlands would sufficiently buffer and protect warbler habitat from impacts due to the proposed action. The large openings created by treatment clear and patch cuts could cause drying of the riparian zone due to increased light and wind, however these changes should benefit some riparian vegetation including willows that tend to die if shaded out by adjacent conifer trees.

Estimation of influence for Proposed Action
Overall, a neutral habitat influence is expected and no changes forest-wide population trends are expected.

Boreal Toad (*Bufo boreas*) and the remaining MIS

(Previously evaluated as both MIS and Sensitive under Sensitive Species section of this report)
There is no viability concern for the boreal toad that is also a sensitive species. Similarly, there are no viability concerns for the remaining MIS.

**Discussion of Other Forest Plan Habitat Attributes**

**Quaking aspen:**
According to the Silvicultural report for the Crystal Lakes Fuels Reduction Project (Johnson 2001), the existing condition for quaking aspen Forest-wide is 7% and the desired condition (Forest-wide) is between 10 & 20%. Quaking aspen clones within treatment units should be retained. Conifers within quaking aspen clones may be cut to maintain clones. Quaking aspen is expected to regenerate across many proposed units if harvest is localized to promote quaking aspen sprouting. There is an anticipated positive influence to this MIC and respective MIS from the proposed project, and as such are consistent with Forest Plan direction for these habitats and species for all alternatives.

**Interior Forest:**
Interior forests are considered to be contiguous areas of relatively dense and large trees that are buffered from the temperature, light, and humidity differences of sizeable openings in the forest, and from human disturbance along regularly used roads and trails (Forest Plan 1997). An estimated 71 mapped acres of interior forest in the Forsythe treatment units 18, 14, 15 and 16. Forest-wide there exists about 193,700 acres of interior forest habitat, 15% of the total ARNF area (USDA FEIS Chapter 3, page 233). The Proposed Action will increase openings through patchcuts and sanitation and removal and expand 9 acres of roads. This project would cause a loss of these 71 acres of interior forest as all units that contain interior forest are proposed to have sanitation and removal. This would contribute to a negative habitat trend for the associated MIS, the golden-crowned kinglet and is reflected in the species analysis. However, units 14-16, have the most interior forest likely to be impacted and have special Project Design intended to maintain the integrity of interior forest and kinglet habitat while still achieving fuels reduction goals. Effects to this MIC and respective MIS for all alternatives are consistent with Forest Plan direction for these habitats and species.

**Montane Riparian/Wetlands**
Riparian corridors, ponds and wetlands occur throughout the treatment units including some willow habitat. Effects to this MIC and respective MIS for all alternatives are consistent with Forest Plan direction for these habitats and species.

**Old Growth**
The Proposed Action would treat approximately 289 acres of old growth. Larger live trees, snags and large downed woody material would be retained unless the stand has succumbed to bark beetles. This is intended to maintain and enhance old-growth if the stands survive the beetle infestation and to leave enough large woody debris to facilitate a future stand of old-growth if it does succumb to beetles or fire. Effects to this MIC and respective MIS for all alternatives are consistent with Forest Plan direction for these habitats and species.
Snags and Downed Woody Debris
Forest-wide amounts of snags are generally high (1997 Forest Plan FEIS, page 208). However, suitable nest trees that have enough rot to be excavated for a cavity and yet remain standing are still somewhat limited. A majority of cavity nest sites observed during field surveys are in large ponderosa or quaking aspen.

Habitat Effectiveness
Effective Habitat is considered to be mostly undisturbed habitat which is buffered from regularly used roads and trails (both motorized and non-motorized travel –Forest Plan 1997). Many treatment units contain effective habitat. The Thorodin Geographic Area has a habitat effectiveness rating of 49%. The Sugarloaf Geographic Area has a habitat effectiveness rating of 51%. These numbers have not been updated to reflect the current density of roads and trails throughout the GeoAreas. Current trail densities and the number of people trips per week has increased dramatically in the last 10 years. The Proposed Action will add 0.8 miles of temporary roads and an unknown number of miles of skid trails within Effective Habitat in Management Area 3.5. While the roads are considered temporary they could remain open for several years while the project is being implemented. This has been shown to lead to heavy local use of the roads and trails even after closure resulting in a long term or permanent reduction in effective habitat.

Caves and Mines
Townsend’s big-eared bats have been recorded at a mine site within 0.25 miles of several treatment units. A Fringed Myotis roost site has also been recorded within the Project Area. Effects to this MIC and respective MIS for all alternatives are consistent with Forest Plan direction for these habitats and species.

Noxious Weeds

Affected Environment
Systematic noxious weed inventories were conducted from 1998 through 2001 for the Winiger Ridge Ecosystem Management Pilot Project (Winiger project), which encompasses most of the Forsythe Project Area. Vegetation treatments have occurred in Winiger project units, including some that overlap proposed Forsythe treatment units. Noxious weed inventories included National Forest System (NFS) lands and lands managed by Boulder County, the City of Boulder, and Denver Water. Additional inventories specific to noxious weeds were not conducted for the Forsythe Project; however noxious weed occurrences were noted during botany surveys in 2010 and 2011. Treatment of priority noxious weed infestations in the project area has been ongoing since 1999 on NFS lands and Denver Water lands, including infestations around Gross Reservoir being treated in cooperation with Denver Water.

In general, except for densely forested areas, weeds are abundant throughout much of the project area due to relatively high road and trail density; past disturbance including mining, timber harvest, and construction of residences, roads, utility corridors, etc.; and high levels of human use, both recreational and residential. Weeds are most abundant along roads and in previously
disturbed areas. Some high priority weed infestations have been reduced or eliminated with years of treatment.

Areas most likely to facilitate introduction of weeds through disturbance and the presence of vectors are roads, trails, stream corridors, dispersed recreation areas, individual residences, horse feeding or riding areas, areas with previous fire or timber cutting activity, wildfires, and heavily grazed areas (currently or in the past). All of these conditions occur in the Forsythe Project area. Once established, weeds may spread to adjacent, less disturbed or even undisturbed areas. Weeds are most likely to establish and spread in open areas that receive plenty of sunlight and less likely to establish and spread in densely forested, more shaded areas. Riparian and open meadow habitats, including grass, forb and shrub cover types, are particularly susceptible to noxious weed invasion, due to the availability of sunlight, and in riparian areas, the presence of water as a vector. Higher elevations tend to have fewer occurrences of noxious weeds, due to a combination of harsh growing conditions that deter some species and generally fewer human disturbances providing sources of introduction.

Noxious weeds known to occur in the project area include diffuse knapweed, spotted knapweed, dalmatian toadflax, yellow toadflax, Canada thistle, musk thistle, houndstongue, scentless chamomile, and oxeye daisy. Other invasive plant species may occur and be undocumented or have the potential to be introduced and establish in the area. Orange hawkweed, a Colorado A list species (designated for eradication) and a high priority species for the ARP and the BRD, occurs near two proposed treatment units but is not known to occur within any proposed units. Canada thistle is by far the most widespread noxious weed in the project area. Musk thistle also occurs in a number of proposed treatment units, but is more sparsely distributed. The highest priority species in the project area are orange hawkweed, diffuse knapweed, spotted knapweed, dalmatian toadflax, yellow toadflax, houndstongue, scentless chamomile, and oxeye daisy. These species are located in relatively few areas, and weed treatments in the project have focused on them, both because of their potential for spread and because of the feasibility of treating the relatively few infestations. Canada and musk thistle have been treated in some areas, where they are near higher priority species and in some locations where they have densely infested landings from Winiger fuels treatments.

Other documented weed species include cheatgrass, common mullein, and smooth brome. These species are not a priority for treatment, either because they are a ubiquitous Colorado List C species as with cheatgrass and common mullein – species where the goal is not to stop the spread of these weeds, but rather to provide additional educational, research and biological control resources to jurisdictions that choose to require management; or because they are not a Colorado designated noxious weed species, such as smooth brome.

Treatment of noxious weeds on the ARP is based on the concept of integrated weed management (IWM) and is consistent with the ARP Noxious Weed Management Plan included in the Decision Notice and Finding of No Significant Impact for Noxious Weed Management Plan on the ARP (2003). The goal of IWM is not total eradication of noxious weeds, but successful long-term management through a combination of biological, chemical, cultural, and physical methods. In general, noxious weeds are prioritized for treatment based on aggressiveness, current extent of infestation, and priority of species by state and county weed programs.
Alternative A – No Action

Direct and Indirect Effects

Over time, without vegetation management or wildfire, surface and canopy fuel loads will continue to increase and the potential for extreme wildfires will continue to rise. Without treatment, all noxious weed occurrences can be expected to continue to spread into disturbed areas and possibly into native ecosystems. The rate of weed spread without further disturbance from project activities would most likely be less than the rate of spread after project implementation. The exception would be if no fuel reduction occurs, and the increasingly dense forests experience extreme wildfire; in that case openings for weed establishment would be created, soil nutrients would be released, and weed spread may be more rapid than spread resulting from proposed fuel reduction activities.

It is difficult to predict whether weed establishment and spread would occur faster after wildfire or prescribed burns (part of Alternative B). The main predictors are severity and extent of the fire. A moderate, patchy wildfire could result in fewer weeds than a more continuous or severe prescribed burn, and vice versa.

Cumulative Effects

Past activities conducted by the Forest Service include the Winiger Ridge Ecosystem Management Pilot Project and timber stand improvement activities decades ago. Fuels treatment activities have occurred on private and Boulder County Parks and Open Space lands within the project area boundary. The construction of Gross Reservoir and associated facilities introduced disturbance and human use that facilitate weed introduction and spread. Past mining activity created disturbance and openings for weeds. All types of recreational use of the area continue to increase, with the potential to introduce and spread noxious weeds. Residential intermix is prominent in several areas including Nederland and along the main state and county roads in and bordering the area, and use of National Forest System lands by area residents is correspondingly high in and near these areas. Construction of new parking areas and camp sites in the Winiger Ridge and Forsythe areas, a cooperative project between Denver Water and the USFS, began in 2010 and is expected to be complete by 2012.

Cumulatively, past and ongoing activities have resulted in soil disturbance, native vegetation removal, modification of hydrology, establishment of many noxious weed infestations throughout the project area, and high risk for invasion in areas not currently occupied. Given the projected continuation and increase of many of these land uses, it is also reasonably foreseeable that the potential for introduction and spread of noxious weed infestations would continue to rise in the future. Continued fuel loading would also increase the potential for a high-severity and/or high-intensity wildfire. Construction anticipated with the Moffat Collection System Project in the vicinity of Gross Reservoir has the potential to introduce and spread noxious weeds. According to the Final Environmental Impact Statement for the ARP Forest Plan (USDA Forest Service 1997), it is reasonable to expect that, left unchecked, noxious weeds will increase at an annual rate of 10 to 15 percent. Weed management programs have been initiated or improved in the past few years on the ARP, including the Boulder Ranger District, and on adjacent lands. In
In general, invasive plant infestations can be expected to increase over time, unless all landowners and managers implement and maintain proactive, integrated weed management programs.

**Alternative B – Proposed Action**

**Direct and Indirect Effects**

In fuels reduction project areas, the risk of establishment and spread of noxious weeds is highest in disturbed areas such as landing and staging areas, burned pile areas, areas with temporary road construction or road reconstruction, other areas of heavy activity, and any other areas where mineral soil is exposed.

Project activities are expected to increase risk of introduction and spread of noxious weeds. This risk is greater where: 1) weeds already occur in or near potential treatment units; 2) project activities involve use of mechanical equipment versus hand crews; 3) project activities involve prescribed fire, including broadcast burning and slash pile burning; d) project activities involve creation of temporary or permanent skid roads, fire lines, landings, and other areas of soil disturbance; and 5) treatments will open up the forest canopy the most, as most weed species grow well in open areas.

Any ground disturbance increases the possibility of invasion and establishment of nonnative plant species. Heavy equipment operation increases soil compaction and ground disturbance, particularly within skid-trail, landing, and temporary road areas, which can increase the risk of noxious weed invasion. Road improvement with equipment also increases weed invasion risk due to both the additional ground disturbance and the potential of introducing weeds with equipment. Fuels treatments that leave some overstory canopy, minimize exposure of bare ground and target sites that already host species capable of resprouting may be less likely to promote invasives, suggesting that patchcuts and sanitation and removal are more likely to promote weed establishment than thinning treatments (Erickson and White 2007). Gibson and colleagues (Erickson and White 2007) also found that plant communities that retain greater levels of overstory shading and litter or surface cover greatly mitigate the risk of increasing exotic plant cover.

Overall ground disturbance is generally less in manually treated areas than in mechanically treated areas. Ground disturbance in manually treated areas is primarily related to burn pile effects. In other areas with similar fuels treatments, Canada thistle is especially aggressive to invading burned pile areas, depending on the seed source, availability of light, and other conditions. These infestations usually occur within one to two years subsequent to burning.

Monitoring of burned slash piles in 2009 in a fuels treatment project on the Canyon Lakes Ranger District showed much variation in percentages of observed slash piles invaded by noxious weeds. Weed invasion in burned piles in four units monitored ranged from 2 to 41 percent. In the two units receiving primarily thinning treatments, weed invasion occurred in about two and four percent of burned piles monitored. In the two units receiving patch sanitation and removal, weed invasion occurred in about 14 and 41 percent of burned piles monitored. These results are consistent with the increased risk of weed invasion in treatment areas that open
up the canopy the most, since patch-cuts open up the canopy more than thinning. Other factors that likely influenced weed invasion in burned piles monitored include weeds present before fuels treatment and methods of fuels and slash treatment, for example hand vs. mechanical.

Approximately 968 acres are proposed for prescribed broadcast burning. Canada thistle is widespread throughout this area, and cheatgrass is widespread especially in the eastern and southern portions of the proposed prescribed broadcast burn area. Musk thistle occurs in a few locations in small patches. In Winiger Gulch, yellow toadflax and houndstongue occur along with abundant Canada thistle. All of these weed species have the potential to be spread by prescribed broadcast burning activities, including vehicles, people, and hand line. Opening up the canopy generally favors weed species, and prescribed broadcast burning would be expected to create areas of soil disturbance favorable to weed invasion and spread. Based on known weed infestations in the area and potential for spread from prescribed burning, weeds, particularly Canada thistle and cheatgrass, would be expected to increase after prescribed broadcast burning.

Studies have found that mitigation strategies may be effective. On sites that exhibit species invasions following wildfire, active intervention with herbicides or other treatments designed to control or eliminate the invasive can be highly effective (Erickson and White 2007). Seeding treatments can increase invasives, especially when not carefully screened for purity (Erickson and White 2007).

Project Design are expected to reduce the risk of weed invasion and spread under this alternative, using feasible and prudent prevention measures including equipment inspection, avoidance and/or treatment of high priority weed infestations, testing revegetation seed for weed seeds, and use of certified weed-free hay, straw, and mulch. Previous inventory and treatment within Winiger project units have helped to reduce or eliminate the highest priority noxious weed infestations in those areas, which include many of the Forsythe project proposed treatment units. Project Design also provide for post-implementation monitoring of areas with the highest risk of noxious weed introduction or spread.

**Cumulative Effects**

Refer to Cumulative Effects section above under Alternative A for the analysis area, time period, and past and ongoing activities for cumulative effects. As with Alternative A, given the projected continuation and increase of many of the past and ongoing activities that cause soil disturbance, it is reasonably foreseeable that the potential for introduction and spread of noxious weed infestations would continue to rise in the future.

Under Alternative B, both direct and indirect effects would be expected to result in an increase in noxious weed infestations over time, contributing to the long term cumulative impacts of increased infestations from other past, present, and future activities. Appropriate Project Design and a proactive weed management program will help to reduce these risks.
Botany

Affected Environment

Most areas potentially impacted by project activities were surveyed for threatened or endangered (TE) plants, sensitive plant species, and other plant species or communities of local concern by the Forest Service Botanist and botany technicians during the summers of 2010 and 2011 at times when target plants were identifiable.

No TE or sensitive plant species were encountered or are suspected. There is no suitable habitat for TE plants, and little suitable habitat for sensitive species. There is suitable habitat for the sensitive plant species dwarf raspberry (*Rubus arcticus* ssp. *acaulis*) in a riparian drainage way in the southeast portion of the project area. Based on habitat absence, and survey intensity and results, no sensitive plants are suspected to be present except for dwarf raspberry, which could be present in the drainage way. It is known to occur several miles to the east in similar habitat. Intensive surveys in rare plant habitat conducted in the past in the Gross Reservoir area in habitats similar to the project area also yielded no sensitive plant species except the raspberry.

There is habitat present for several species of local concern, and numerous populations of the following local concern species are present in several proposed units as well as along some roadides or unit access points that could be impacted by project activities: tall blue lettuce (*Lactuca biennis*), dwarf red blackberry (*Rubus pubescens*), forked spleenwort (*Asplenium septentrionale*), Simpson hedgehog cactus (*Pediocactus simpsonii*), wild sarsaparilla (*Aralia nudicaulis*), calypso orchid (*Calypso bulbosa*), wood lily (*Lilium philadelphicum*), polypodium fern (*Polypodium saximontanum*), yellow coralroot (*Corallorhiza trifida*), spring coralroot (*Corallorhiza wisteriana*), and western brackenfern (*Pteridium aquilinum*). Additionally, Colorado blue spruce (*Picea pungens*), the state tree, is present in a drainageway in the south-central portion of the project area. A plant community of “high biological concern” to the Colorado Natural Heritage Program, the water birch (*Betula occidentalis*)/starry false lily of the valley (*Maianthemum stellatum*) shrubland occurs in a riparian area in the southern portion of the project area. There is a wet area containing the sensitive plant lesser bladderwort (*Utricularia minor*) and the species of local concern wollyfruit sedge (*Carex lasiocarpa*) at a reservoir/lake on private property within the analysis area that is not part of the proposed project. No other species or communities of concern were encountered or are known to occur. The Gross Reservoir surveys to the east encountered the following species of local concern: Rocky Mountain Sedge (*Carex saximontana*), Dewey sedge (*Carex deweyana*), Sprengel sedge (*Carex sprengelii*), false mellic (*Schizachne purpureascens*), and Maryland sanicle (*Sanicula marilandica*). These species were not encountered in the project area, but some habitat is present for them, and it is possible that they could be present and were overlooked.

Alternative A – No Action

Direct and Indirect Effects

Plant species of local concern
The species of local concern found in the project area are secure in viability in the Planning Area, and additional, sometimes numerous, populations exist elsewhere on the forest that are not currently being adversely impacted.

Under the No Action Alternative, plants of local concern would not be subjected to adverse impacts associated with the proposed project. On-going possible impacts to plants would continue, such as incidental wildlife or livestock herbivory or trampling, crushing by falling trees, or burning by wildfire. Off-road incidental use by humans (hiking, hunting, unauthorized off-road ATV, etc.) occurs in the area, and could occasionally harm or kill a plant or cluster of plants. The degree of impacts associated with such actions would not be anticipated to result in reduced long-term viability of any local concern species.

Cumulative Effects

As there are no direct or indirect effects to TE or sensitive plant species, there are no cumulative effects. For local concern species, impacts associated with on-going activities such as grazing and use by humans, or wildfire, are believed to be inconsequential regarding impacts to long term viability in the Planning Area and local area. Therefore, there are no incremental additional cumulative impacts to such plants.

Alternative B – Proposed Action

Direct and Indirect Effects

TE plant species
The following threatened or endangered (TE) plants were initially considered for analysis because they are known to occur in riparian areas at the base of the foothills, downstream from the project area: Ute ladies’-tresses (*Spiranthes diluvialis*) and Colorado butterfly plant (*Gaura neomexicana* subsp. *coloradensis*). Another listed riparian species, Western prairie-fringed orchid (*Platanthera praeclara*), occurs along the main stem of the Platte River in Nebraska. These plants could be impacted by water depletions along the Front Range. No TE plants are known or suspected to occur in the proposed project area or other areas potentially impacted by proposed project activities, such as access roadways or staging areas. There is no suitable habitat for any TE plant species in or near the project area or areas potentially impacted by proposed activities. There are no downstream water depletions associated with the proposed project, so no downstream riparian TE plant species would be impacted under current conditions or actions associated with the proposed project. Therefore, an effects determination of “No Effect” is warranted under all alternatives for these TE plants.

Sensitive plant species
No sensitive plant species are known or suspected to occur in areas potentially impacted by proposed project activities. The sensitive plant that is most likely to occur in the project area, dwarf raspberry, would be limited to a riparian area that would not be impacted by the proposed project. There is no threat to that drainage way under current conditions. Therefore, an effects determination of “No Impact” is warranted for both alternatives for that species. See the botany
Project Design for procedures regarding unsurveyed units and conservation conditions if sensitive plants were to be found.

**Plant species of local concern**

Some individuals of all local concern species could be subjected to being crushed, burned, or killed by proposed project activities. Most plants would be anticipated to remain undisturbed however, by the light and patchy nature of the proposed project prescriptions.

For the relatively more common species calypso orchid, no mitigation measures would be employed for its protection. The following local concern plants would also not be protected by project measures, but they occur in cracks of rocks and other naturally protected microsites (steep rocky slopes) such that project activities would not be likely to adversely impact plants, or would impact very few plants: forked spleenwort and polypodium fern.

For the following species of local concern, at least 20% of all plants known to occur in the project area would be protected by buffers or other measures implemented during project activities as stated under the botany Project Design, such that adverse impacts to protected sites would be avoided: Simpson hedgehog cactus, yellow coralroot, spring coralroot, and Colorado blue spruce. Similarly, for the following more rare or noteworthy species, 100% of all plants would be protected, if feasible: wood lily, wild sarsaparilla, tall blue lettuce, dwarf red blackberry, and western brackenfern.

For all species, the number of plants potentially adversely impacted would increase relative to the amount of area disturbed in occupied sites by proposed project activities. Impacts from the Action Alternative would be anticipated to be relatively greater than those under the No Action Alternative.

In all instances, implementation of the proposed action alternative would not be expected to adversely impact enough plants to compromise long term viability at the local level or across the Planning Area, due to sufficient numbers of secure plants residing elsewhere and the proposed protection of some sites of the rarer plants.

**Plant community of concern**

Under the water birch/starry false lily of the valley shrubland, which occurs in a riparian area in the southern portion of the project area, is currently not under threat. Under the Action Alternative, Project Design that would protect riparian areas would also protect this associated community. Some plants could be crushed, trampled, or killed if outside of the riparian buffer, but the community viability would remain intact.

**Cumulative Effects**

As with the No Action alternative, because there would be no anticipated direct or indirect effects to TE or sensitive plant species, there would be no cumulative effects. For local concern species, impacts associated with the proposed project as well as on-going activities such as grazing and use by humans, or wildfire, would be anticipated to be inconsequential regarding
impacts to long-term viability in the Planning Area and local area. Therefore, there would be no incremental additional cumulative impacts to such plants.

Social Environment

This section will describe the affected environment and environmental consequences for each alternative to the Social Environment (Social and Economics, Recreation, Scenery, Lands, Minerals, and Special Uses, Transportation, Recreation, and Heritage).

Social and Economics

Affected Environment

The Forsythe Fuels Reduction project area is located within Boulder and Gilpin Counties, Colorado.

Boulder County:
Although slowing over the last several years, Boulder County has experienced steady population growth over the last forty years. In 2010, the estimated population was 294,567 with 33 percent of that number living in the city of Boulder. Major employers include several software and computer manufacturing firms and healthcare providers. Agriculture, while still a factor in the county economy, is gradually losing ground as lands are developed for housing and water rights are converted from agricultural to municipal use where designated open space does not exist. Agricultural income has decreased 15 percent since 2000.

When compared to counties nationwide, Boulder County is very affluent and educated. According to figures from the 2010 census, the median household income was $55,861. Boulder County ranks 85th out of the 3,140 counties in the nation. Only 9.5 percent of County households earn below $22,050, which is considered the poverty level for a family of four. Over 52 percent of Boulder County residents have received a Bachelor’s Degree or higher ranking it 9th out of all the counties in the nation (DataPlace.org).

The nonfederal land within the Forsythe project area contains a mix of rural residential properties, ranches, county open space, and municipal water property. As opposed to some mountain communities, many of the residents live here year round and commute to Boulder and Denver for work or shopping. Historically, private land was developed through homesteading or through minerals patents issued under the 1872 mining laws. Over time, some of the areas have been sold and subdivided into smaller lots ranging from 0.1 to 250 acres in size. Because of the level of development, there is an extensive network of roads and utilities serving the private land.

Larger ownerships in the project area contain land owned by Denver Water and private landowners. Denver Water property contains Gross Reservoir which provides municipal water to the city of Denver and provides recreational opportunities.
Gilpin County:
Although slowing over the last several years, Gilpin County has experienced steady population growth over the last forty years. In 2010, the estimated population was 5,441 with 43 percent of its residents living in rural areas. Accommodation and food services in the communities of Black Hawk and Central City employ 97 percent of the residents.

When compared to counties nationwide, Gilpin County is relatively affluent and educated. According to figures from the 2010 census, the median household income was $30,798. Gilpin County ranks 165th out of the 3,140 counties in the nation. 7.3 percent of County households earn below $22,050, which is considered the poverty level for a family of four. Over 31 percent of Gilpin County residents have received a Bachelor’s Degree or higher ranking it 184th out of all the counties in the nation (DataPlace.org).

The nonfederal land in Gilpin County within the Forsythe project area contains a mix of rural and residential properties. As opposed to some mountain communities, many of the residents live here year round and commute to Boulder, Denver, Black Hawk, and Central City for work or shopping. Historically, private land was developed through homesteading or through mineral patents issued under the 1872 mining laws. Over time, some of the areas have been sold and subdivided into smaller lots ranging from 0.1 to 150 acres in size. Because of the level of development, there is an extensive network of roads and utilities serving the private land. Larger ownerships in the project area contain land owned by private landowners who operate ranches.

Alternative A – No Action

Direct and Indirect Effects
Under Alternative A, no hazardous fuel reduction activities would occur to alter wildfire behavior and reduce the risk of economic loss to these areas. The amount of private homes and infrastructure would be expected to slightly increase or remain the same. The potential loss of or damage to infrastructure, such as electrical transmission and communication lines, from a wildfire would not be reduced.

Under the No Action Alternative, there would be no direct costs to the federal government associated with completing the treatments. If no fuel reduction treatments were completed, it is likely that fire suppression costs as well as other economic and social costs would be higher during a wildfire event.

The per-acre cost of suppressing wildfires is highly variable. Primary factors that influence costs include number of acres involved, weather conditions, fuel types, the physical location of the fire (e.g. adjacent to private property), and the tactics used to suppress the fire. Because of the threat to life and property, fire ignitions near subdivisions and developed properties are aggressively suppressed and therefore can have higher per acre costs. Typically, smaller, less intense fires are less expensive to control; therefore, if hazardous fuel reduction treatments are not completed, the cost of fire suppression would not be reduced.

In addition to direct costs of suppression, indirect costs of fires would include temporary reduction in property values, losses of uninsured property, and costs to replace infrastructure.
such as utility lines, roads and water treatment facilities. Any necessary emergency rehabilitation costs to control erosion and potential damage to watersheds would also increase costs. Because of the high degree of variability involved, these indirect costs are difficult to average; however, given the high degree of private property development within the Forsythe area, and the proximity to Gross Reservoir, there is potential for a sizable increase to the economic impacts of wildfire.

**Cumulative Effects**
Under the No Action Alternative, hazardous fuel reduction treatments would continue to take place on adjacent private property without the benefit of treatments on adjacent National Forest System lands. If markets develop for products that utilize smaller diameter material such as industrial type pellets for energy, the ability to offset treatment costs would improve. Land that is currently vacant would likely continue to be developed increasing the amount of infrastructure and values at risk to wildfire.

**Alternative B – Proposed Action**

**Direct and Indirect Effects**
Implementation of Alternative B would allow for hazardous fuel reduction treatments on a maximum of 4,335 acres, and 968 acres of broadcast prescribed burning. Effects to the adjacent landowners would include noise from chainsaws or mechanized equipment during tree cutting operations. There would also be a temporary increase in the amount of traffic on roads used to access the treatment areas. When slash from the tree cutting operations is piled and burned, smoke may be noticeable to private landowners. Depending on the size of the crew and/or the type of equipment, between 5 to 40 acres of thinning could be accomplished per day. Based on this rate, the effects to individual landowners would be short term.

Implementation of broadcast prescribed fire would produce smoke that would be noticeable to residents in the area. Prescribed burns are conducted under weather conditions that allow smoke to rapidly disperse; however, there could be instances during a burning period when smoke would be visible to adjacent landowners. These effects would also be short term and infrequent.

The cost of treating the proposed units is highly variable. If thinning treatments are completed by hand crews with chainsaws, costs currently average $300-$600 per acre. An additional $100 per acre cost is typically incurred for Forest Service crews to burn the hand piles. If thinning treatments are completed with mechanized equipment such feller bunchers, boom-delimiters, harvesters, and skidders; costs average over $1000 per acre.

Again, given the variability involved, it is difficult to directly correlate the number of acres treated with the number of acres that would be burned in a wildfire. However, any reduction in fire size and intensity would translate to a reduction in fire suppression costs and reduce potential losses of private infrastructure.

Under certain conditions, treatment costs can be partially offset through the sale of forest products and the proposed action considers this possibility. These sales could either be “stewardship” type contracts where the stumpage cost of the product would be used to offset the
cost of the treatment, or, sold to a purchaser through the appropriate timber sale contract. Several factors limit opportunities to recover costs from projects located along the Colorado’s Front Range. First, the majority of the material that needs to be removed consists of smaller diameter trees and currently there is not a high demand locally for products that can be processed from this size of material. Secondly, ponderosa pine, Douglas-fir, and lodgepole pine are the main tree species that would be cut. With the exception of firewood and perhaps wood chips, mulch, or posts and poles, there are few products that can be manufactured from these trees. Lastly, roads on National Forest System lands within the Forsythe project area are generally not designed for efficient removal of commercial forest products further limiting options for offsetting treatment costs.

Cumulative Effects

Executive Order 12898, Environmental Justice, requires all federal agencies to consider the effect of a proposed action on low income and minority populations. From the 2000 Census data, 79.4 percent of the population in Boulder County and 90.9 percent in Gilpin County is white with the Hispanic or Latino population estimated at 13.3% in Boulder County and 4.9 percent in Gilpin County (2010 US Census). Figures for landownership by race or ethnicity are not available specifically for the project area; however, there is no information that would suggest any higher proportion of minority populations. The average household incomes in Boulder County of $72,512 and Gilpin County of $59,402 are well above the $22,050 that is considered the Federal Poverty Guideline. Based on these numbers, implementation of either alternative would not be expected to have negative impacts to low income or minority populations.

Scenery

Affected Environment

The area is located in the ‘M331 Southern Rocky Mountain Steppe subecoregion (Bailey et al., 1994). The project area is one of an aspect-dependent dry continental forest. Precipitation is around 20 inches per year, with about a half of that coming in the form of snow. The growing season is about 70 days. The elevation of the land varies from 7,000-9,000’. The area is moderately to well-dissected. There are two permanent streams in the area — South Boulder Creek and Middle Boulder Creek. Most other drainages are intermittent. The vegetation varies from open areas with grasses and shrubs to conifer trees and deciduous species. There are a few small (less than 5 acres surface area) natural and dam-enhanced ponds in the project area on private land. There are also two impoundments for water storage: Barker Reservoir, a lake of approximately 400 surface area acres on Middle Boulder Creek and Gross Reservoir, an approximately 1,000 surface area acres lake on South Boulder Creek. Large wildlife consists of moose, deer, bear, mountain lion and elk in the winter. The air is generally clear, the sky is often a deep blue and the views can be long. In the past the area was used by hunter-gatherers and grazing has occurred. There is residential and second-home development throughout and adjacent to the project area. There is evidence of past timber activity in the area and currently there is some forest thinning and patchcutting in the project area. There is activity to reduce
fuels on the private land in the area. There is also evidence of a large recent fire to the north and east of Gross Reservoir.

The main highways that provide access to the area are the Boulder Canyon highway (Colorado State Highway [CSH] 119) forming the northwest boundary of the project area, the Coal Creek Canyon Road (CSH 72) forming the southwest boundary of the project area, the Peak-to-Peak Scenic Byway (various segments of CSHs 119 and 72) on the west of the project area, the Flagstaff Mountain Road on the east, and the Magnolia Road (County Road 132) which bisects the project area. In addition there is the main east-west Amtrak transcontinental passenger railroad route in the south portion of the project area.

The desired landscape character is a ‘natural-appearing’ landscape. Grasses and shrubs dominate the meadows and the south slopes with ponderosa pine being the dominant tree species. The north slopes are well-timbered with ponderosa pine, Douglas-fir and lodgepole pine at the higher elevations. The east and west slopes are moderate to well timbered with all these tree species. Quaking aspen occurs in the meadows and drainages along with Colorado blue spruce. There are many rock outcrops in the area. It is a classic western landscape with ponderosa pine, quaking aspen, meadows and rock outcrops common. At the time of this writing the existing scenic integrity is moderate to high.

Fire plays an important role in this ecoregion. There are areas of recent severe burning that have had large negative scenery impacts on the landscape. Within the project area is an expanse of land north and east of Gross Mountain Reservoir and there are numerous locations near the project area such as the Four Mile Canyon and the Overland fire areas. Suppression of fire through human intervention in other parts of the project area has made the existing forest landscape denser with vegetation than would be occur if ecological processes were allowed to operate without human intervention. As a result, many portions of the project area could be thought of as having a higher degree of instability of the scenic attributes than would ‘naturally’ occur. The existing scenic stability is high in those areas of recent fire activity and low in those areas of fire suppression.

Landscape visibility refers to several criteria that define how obvious changes to the landscape such as road construction, tree removal, or other human development may be. Criteria include distance from viewer, number of viewpoints, and duration of view, topography, and visual absorption capability (the ability of the landscape to absorb visual change). The analysis area for scenery for this project contains numerous important viewer locations and both wide panoramic views and detailed foreground views, some of which are shown in this report. The variety and diversity of tree species and presence of natural openings and rock outcrops makes the landscape able to absorb changes without these changes being too obvious and so this landscape has a relatively high visual absorption capability.

Viewpoints of interest include those from the roads mentioned above, the roads that feed these main roads, the numerous informal trails and the numerous residences and second homes in the area, the Amtrak railroad tracks and the surface of and recreation areas around Gross Reservoir.
Management Direction – Forest/Grassland Plan Direction

The area is listed as the ‘Sugarloaf, Thorodin and Lump Gulch Geographic Areas in the LRMP. The vast majority of the area is listed as Management Area (MA) ‘3.5- Forested Flora and Fauna Habitats’ whose emphasis is land and resource management for plants and animals. Language applicable to the scenery resource given in the LRMP includes “Disturbances may be fairly evident and the scale may vary from small to large. Design vegetation changes to resemble natural patterns.” (LRMP p. 358)

There are also two areas on the northern portion of the project area that are MA ‘7.1 – Residential – Forest Intermix’. One on the east end of that northern portion near Boulder and one on the west end near Nederland. Language applicable to the scenery resource given in the LRMP includes “Manage forested areas to attain a natural appearance and minimize the risks of catastrophic fires and epidemic levels of insects and diseases.” “New improvements are designed to resemble natural patterns and to be less intrusive into the landscape.” (LRMP p. 380)

Of particular importance to the scenery resource is- one area of MA ‘4.2 – Scenery’ adjacent to the Peak-to-Peak Scenic Byway (CSHs 72 & 119) at the western end of the project area. The theme listed there is: “Areas are managed to protect or preserve scenic values and recreational uses of designated scenic byways and other heavily used scenic travel corridors.” Also “Emphasize the health and appearance of these communities to maintain their important scenic qualities. Vegetation alterations may be carried out to enhance viewing opportunities and to maintain long-term vigor and health of the vegetation. Vegetation activities are, however, kept visually subordinate to the surrounding landscape.” (LRMP p. 364)

There are three areas of High SIO. One is in the northeastern portion of the area around Magnolia Rd (CR 132), the Boulder Canyon Rd. (CSH 119) and around the Twin Sisters Mt. (on the flanks not on the top plateau). Another area is on the east side of the project area near the Peak To Peak Scenic Byway (CSHs 72 & 119) and the town of Nederland. The third area is on the southeast side of the project area southwest of Gross Reservoir along the railroad route. A High SIO is defined as a landscape that ‘appears intact’. Deviations from natural conditions may be present, but they are not evident.

The ‘Scenic Integrity Objective’ (SIO) for the remainder of the area is ‘Moderate’. The Moderate SIO is defined in the ARP Land and Resource Management Plan as “Alterations to the natural landscape may be apparent, but they are visually subordinate to natural features. Management activities such as timber harvest and roading may occur, but must be designed so they blend into the natural landscape.”

Alternative A – No Action

Direct and Indirect Effects

The project area would continue to show the effects of fire suppression and recreation impacts. Effects would include a forest more dense with vegetation from fire suppression and more soil compaction, erosion, tree scarring and littering resulting from recreation use. Existing timber harvest areas would continue their regeneration and those areas would eventually be considered
visually ‘recovered’ (meaning the area is well-stocked according to the 1997 Forest Plan and trees are 20 feet in height.

Clearcut areas will have ground visible in some areas (green, beige or white depending on the season) and then the ground will be less visible as the clearcuts regenerate. Existing thinned areas will be moderate in their visual nature in that stumps and slash resulting from thinning activities will become less noticeable over time.

Indirect effects would include a condition of a more dense forest if the mountain pine beetles (MPB) do not reach epidemic levels and a lighter forest with greater forest inter-visibility with much deadfall in the coming years if the MPBs do cause heavy mortality.

Another indirect effect could be a catastrophic fire and the major adverse visual effects that would result from such an event.

**Cumulative Effects**

Projects that are presently active in the analysis area are the Winiger Ridge Fuel Reduction Project. The Forsythe Fuels Reduction Project is to the west of the project area. Activities from these projects are noticeable in the foreground in these areas, but not in the middleground or background and do not violate the SIOs for the area.

There are no cumulative effects beyond that described in the direct and indirect effects

**Alternative B – Proposed Action**

If proposed actions are exercised with above ‘Project Design’ listed in this document the desired landscape character, the scenic integrity and the scenic stability will conform to the LRMP.

**Direct and Indirect Effects**

The intention is that this activity will lessen the intensity of wildfire and its negative implication for the area and adjacent communities and cultural developments.

**Direct Effects**

Direct effects would include the negative short-term effects of the work necessary at all the sites in the project area (cutting, piling, burning, skid roads, landings, smoke, noise etc.)—a moderate adverse effect.

This action would also cause greater interforest visibility and a greater variety in forest vegetation. The effects in the areas of activity would be raw--fresh-cut stumps and slash, chips, masticated material, burn pile scars, and broadcast burn areas. With no MPB infestation this evidence of activity would not be noticeable to the casual forest visitor after a few growing seasons and have only minimal long-term effects. With sanitation and removal treatments these activities will be highly noticeable to the casual forest visitor in the short term. With sanitation and removal treatments, openings would be much larger than that envisioned when scenery
criteria were established in the Forest Service Handbooks and the LRMP (Forest Plan). However, in the long term, where SIOs do apply, both actions would comply with the LRMP. The thinning and the treatments in and around quaking aspen stands would have minimal visual impact except in the immediate foreground; these treatments and would also encourage quaking aspen spread.

The noise, smoke and fire from operations described in the ‘Proposed Action’ would be sporadically present and would be a direct effect. Black ground and blackened tree boles would also be direct effects.

The slash treatments are lopping and scattering, chipping, masticating and piling and burning. Lopping and scattering will have immediate impacts, but they will diminish over time. Project Design for lopping and scattering, chipping and mastication will define an appropriate level for these activities. The activities would vary in the severity of their short-term (i.e. 0-20 years) negative impacts according to their level of treatment depending on MPB infestation, but should not have long-term (i.e. 20+ years) negative repercussions for the scenery resource. The piles will be of a scale according to the Project Design and the majority will be burned in the near future in a case of no MPB infestation. Unless some density limits are established burning of the piles could be a challenge after sanitation and removal was implemented because they piles be of such a magnitude that they cannot be burned in a timely manner. Some will be left for wildlife, but these will not dominate the landscape and will be located out of sight of sensitive viewpoints along roads and use areas wherever possible. The long term visual impact of the burn areas themselves is not expected be noticeable to the casual observer in the case of no MPB infestation, however, with sanitation and removal treatments in the absence of density controls they could dominate the landscape and render it difficult to establish new vegetative cover.

There is no permanent road construction scheduled with this work. Skid trails should be located according to general contract specifications and Project Design and their visual impact will meet the SIO for these areas.

Indirect Effects
Indirect effects from skidder activity and pile burning etc. could also include some soil compaction, erosion, lack of vegetative cover, and some soil sterilization, particularly in pile and burn areas. There is also the possibility of blowdown from the opening up of stands. These effects could include openings in tree cover of the forest landscape, black circles from pile burns and two-tracks through the forest from skidder activities. Indirect effects could also include also the smoke effects on and off-site such as decreased visibility.

Indirect effects would also include the increased ‘openness’ of the forest landscape due to the vegetation manipulations and the potential for increased access and use afforded by this more open landscape.

This increased openness of the forest and ground disturbance activities will also result in greater vegetation variety. Indirect effects would also include a forest that is less susceptible to insects, disease and fire and probably more stable from a visual resources viewpoint because it is less susceptible to drastic change.
Cumulative Effects

Projects that are presently active in the analysis area are the Winiger Ridge Fuel Reduction Project. The Forsythe Fuels Reduction Project is taking place to the west. Activities from these projects are noticeable in the foreground in these areas, but not in the middleground or background and do not violate the SIOs for the area.

With the implementation of this alternative, the landscape in the project area could go from ‘moderate’ to ‘high’ scenic stability.

Land, Special Uses, and Minerals

Affected Environment

Within the project area, there are 7 road use authorizations. These are a combination of permits and easements. A permit provides permission, without conveying an interest in land, to occupy and use NFS land. An easement conveys a limited and transferable interest in NFS land, usually long term.

Several utility distribution lines have been authorized within the project area. These utilities include electricity, natural gas, water and communications. The electric, natural gas and communications lines have been authorized by the Forest Service. The water line has been authorized by the Federal Energy Regulatory Commission (FERC).

There are 2 power site projects authorized by FERC within the project area. The Gross Reservoir Hydroelectric Project, operated by Denver Water, and the Boulder Canyon Hydroelectric Project, operated by the City of Boulder, is partially on NFS land.

A search of the BLM minerals database indicates there are 4 active mining claims in the project area. The holder of a valid mining claim is entitled to possession of the claim for mining purposes. The United States maintains the right to manage and protect NFS resources, but the Forest Service must respect claims and claimants’ property by using precautions to avoid damage to claim corner markers, excavations, and other mining improvements and equipment. At the time of this report, there are no approved or proposed Plans of Operation in the project area.

Alternative A – No Action

Direct and Indirect Effects

Direct Effects
There would be no new effects to the existing authorizations and mining claims.
**Indirect Effects**

If the Forest Service is unable to promote a healthier forest, adjacent land owners may need to request authorization to remove dead or dying trees adjacent to their driveways and property. There would be no new effects to mining claims.

**Cumulative Effects**

There should be no additional cumulative effects to authorized uses and mining claims.

**Alternative B – Proposed Action**

**Direct and Indirect Effects**

**Direct Effects**

The forest should be healthier, reducing the risks of dead or dying trees to authorized uses and mining claims. The United States may need to perfect legal access along some road alignments prior to implementation.

**Indirect Effects**

Through implementation of this project, the United States may have the opportunity to acquire/grant (reciprocal) access.

**Cumulative Effects**

There should be no additional cumulative effects to authorized uses and mining claims.

**Transportation**

**Affected Environment**

The GIS data base for the project area includes approximately 110 miles of inventoried roads within the Forsythe Project Area boundary. Included in the inventory are roads under the jurisdiction of:

- The State of Colorado 24 miles
- National Forest Service 60 miles
- Local County 20 miles
- Private Landowners 8 miles

Many of the project roads have mixed and segmented jurisdiction. The Major Roads shown in Table 26 will be used only for transportation of products and equipment to and from the project area and will not be used for project activities. Table 27 shows “Other Roads” that are not Major Roads, and of these, approximately 53% are inventoried as being under Forest Service jurisdiction. These roads will provide direct and indirect access for project activities.

In the project area, existing National Forest System Roads (NFSR’s), under Forest Service jurisdiction, are primarily single lane native surface roads maintained for high clearance vehicles and are generally not through roads but dead-end roads providing access to recreational
opportunities. Table 27 shows a breakdown of project roads by Maintenance Level as noted in the GIS database.

Table 27 shows the majority of roads in the project area are Maintenance Levels 1 through 3, which indicates significant road improvement may be required to bring these roads to a standard suitable for the proposed action. Field review noted the Level 1 roads were often obliterated in places, the Level 2 roads are narrow, steep in places with rutting, and drainage issues. Construction actions required to use these roads for project needs may include:

- Surface grading
- Removal of rolling dips
- Roadside brushing/tree cutting
- Widening
- Addition of passing lanes
- Reconstruction
- Installation of culverts
- Improvements to stream crossings
- Relocation to achieve more favorable grades (short segments not significant in length)
- Drainage Improvements
- Additional turnarounds

Where roads are not under the jurisdiction of the Forest Service, permission from owners would be required to make these improvements and to use these roads for project activities.

**Table 26 - Major Roads in Project Boundary**

<table>
<thead>
<tr>
<th>Name</th>
<th>Jurisdiction</th>
<th>Function</th>
<th>Maintenance Level</th>
<th>Maintained By:</th>
<th>Approx Miles</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnolia Road</td>
<td>NFS/County</td>
<td>Collector</td>
<td>4-5</td>
<td>County</td>
<td>12.0</td>
<td>No logging trucks east end due to hairpin curves and steep grades</td>
</tr>
<tr>
<td>State Hwy 72</td>
<td>State Highway</td>
<td>Arterial</td>
<td>5</td>
<td>State</td>
<td>11</td>
<td>Sections with sharp curves and steep grades</td>
</tr>
<tr>
<td>State Hwy 119</td>
<td>State Highway</td>
<td>Arterial</td>
<td>5</td>
<td>State</td>
<td>13</td>
<td>Seasonally high traffic volumes, goes through town of Nederland</td>
</tr>
</tbody>
</table>
Table 27 - Other Roads in Project Boundary

| Maintenance Level | Jurisdiction | | | |
|-------------------|-------------|-------------|-------------|
|                   | Forest Service (miles) | County (miles) | Private (miles) |
| NULL              | 10          | 2           | 2           |
| 1                 | 22          | 0           | 0.5         |
| 2                 | 20          | 3           | 5           |
| 3                 | 2           | 2           | 0.5         |
| 4                 | 0           | 8           | 0           |
| 5                 | 0           | 0           | 0           |
| TOTAL (MILES)     | 54          | 15          | 8           |

Note: not all roads will be utilized by the project activities

Alternative A – No Action

The existing transportation system will continue to be maintained to the extent possible.

Direct and Indirect Effects

Direct Effects
Under this alternative there would be no immediate impact to the existing transportation system. Road maintenance that would have been performed by the project would not occur; deferred maintenance of the transportation system would continue to increase.

Indirect Effects
Under this alternative current vehicle use patterns would likely continue. The long-term watershed condition and terrestrial and aquatic wildlife habitat may degrade due to runoff and sedimentation from the lack of maintenance of the existing road prisms and stream crossings.

Cumulative Effects

Other actions in the project area would have temporary impacts to area roads during construction that may include increased sediment and erosion and road damage, these impacts would be mitigated through implementation of best management practices and repairs at completion of the projects. The Gross Reservoir project includes closing and restoration of some roads and trails which will reduce resource damage and meet the Forest Plan goals.

Alternative B – Proposed Action

Road improvements, temporary road construction and drainage work would follow the proposed Project Design and implement Best Management Practices (BMPs) to reduce impact to the natural resource. It is recommended that law enforcement proactively patrol the area after project implementation to prevent illegal use of temporary roads or illegal cross-country travel. All temporary road construction should be decommissioned within one year of the completion of the
activity. Road improvements should be assessed to see if the resource would benefit from their removal at the end of the project.

Direct and Indirect Effects

Direct Effects
Under this Alternative, no new permanent roads will be added to the system for this project. An anticipated 10 miles of temporary access roads would be constructed and then obliterated within one year of the use being complete. Existing roads may need to be improved to accommodate project activities, such improvements may include:

- Surface grading
- Removal of rolling dips
- Roadside brushing/tree cutting
- Widening
- Addition of passing lanes
- Reconstruction
- Installation of culverts
- Improvements to stream crossings
- Relocation to achieve more favorable grades (short segments not significant length)
- Drainage Improvements
- Add turnarounds

The construction of these types of improvements and of temporary roads proposed may impact natural resources by removal of vegetation and through sediment runoff if controls are not implemented. These improvements may also improve watershed conditions by improving sediment, erosion and drainage of the area roadways. It is recommended that improvements made to the system roads for the project, be assessed at the end of the project and removed if it is a benefit to the resource.

Also, under the proposed action, use of existing unauthorized roads as temporary roads to access treatment units will then allow for the decommissioning of these routes on completion of the project. Decommissioning should include restoration of the natural drainages, re-contouring of the road prism to match the existing ground, re-vegetation (seeding), and blocking of the access to discourage continued illegal use of the roads. Decommissioning would reduce resource damage and meet the Forest Plan goals.

Indirect Effects
The increased project traffic in the area may increase erosion and sedimentation in the watershed while the activity is present. Temporary road construction may attract unplanned uses, such as Off–highway Vehicle (OHV) recreation use, if the temporary roads are not controlled. The thinning of fuels associated with the project could make illegal cross-country motorized travel easier in certain places and/or make it easier to drive illegally around gates and other road blocks.
Cumulative Effects

Construction traffic from other projects on area roadways being used for the proposed action would add to potential for road damage, sediment runoff and resource damage due to road improvements needed. Other actions that utilize temporary roads in the project area would add to the resource impact of temporary roads proposed under this action. Best management practices and decommissioning of roads under other actions will enhance the same action being proposed under the proposed action and will reduce resource damage and meet the Forest Plan goals.

Recreation

Affected Environment

The Forsythe Fuels Project Area has a high density of roads, mining impacts, and a very fragmented landownership pattern with a significant amount of private land intermixed with public land. The area contains numerous Forest System roads and trails that cross both National Forest land and private land. The area is in close proximity to Denver, and consequently receives a large number of recreational visitors during summer months. The project area is accessible from Hwy 119, Hwy 72 and several well-maintained county roads that provide opportunities for viewing scenery and driving for pleasure.

Recreation Use (General)

Recreation use in the project area occurs to varying degrees on all National Forest System (NFS) lands. The area is open year-round, with most use occurring between spring and late fall. Ninety-five percent of all recreation uses are non-motorized and mechanized dispersed recreation activities that include hiking, mountain biking, hunting, fishing, camping and horseback riding, and incidental winter sport activities. Motorized access is centric to private landowner ingress/egress, except on weekends when recreation enthusiasts visiting from outside the local area park along roads where public land is legally accessible. Areas known to have the highest use include: NFS lands just south and east of the Town of Nederland and popular destination sites within and around the Gross Reservoir Recreation Area. Areas within the project area with the lowest use are generally found in the Beaver Creek community, the southernmost section of the planning area.

Regulatory Compliance

Users have been observed recreating in what appears to be a safe and compliant manner. The issuance of recreation-related violation notices (citations) is low compared to other areas on the Boulder Ranger District that have similar recreation use dynamics. However, it is widely known that user safety is compromised and compliance issues escalate when large scale projects such as described in the proposed action are implemented. The BRD has been successful minimizing these issues by effectively planning implementation contingencies and communicating project work with the local community. This has provided users and local landowners alike an opportunity to establish expectations well in advance, this typically results in users opting to engage in a different recreation activity during their leisure time. Temporary recreation activity displacement has become a common norm in the project area. Nonetheless, a small percentage
of users and/or private landowners remain that ignore or act defiantly in response to project work on public lands making recreation displacement appear to be a larger issue than perceived.

Common problems include but are not limited to dumping residential trash, vegetation removal, motor vehicles off-road and/or parked in undisturbed areas, soil compaction, randomly placed campfire rings, creation of unauthorized social trails, entering a closed area, and undesirable trespass through private property with intent to access NFS or other public lands managed in the project area. In particular, fuels treatment burn piles and areas that have not been reforested after fuels treatment and located along roads and trails become an attractive nuisance that further exacerbate these issues and perpetuate problems associated with target shooting.

General Concentrated Use Areas
The following concentrated use areas have been summarized to describe the recreation resource.

- Nederland and Front Range Trails Areas
- Porter Ranch and Magnolia Hill Areas
- Twin Sisters and Forsythe Areas
- Gross Reservoir Recreation Area
- Pinecliffe and Tungsten Mountain Areas
- South Beaver Creek and Thorodin Mountain Areas

Other Recreation Destinations
This section identifies other publicly managed lands/areas/sites in the vicinity that may interact in some manner with the recreation resource on NFS lands within the project area. Interaction generally comes in the form of multi-jurisdictional and/or transportation connectivity.

- Town of Nederland Trail System
- Reynolds Ranch Open Space (Boulder County)
- Barker Reservoir
- Barker Feedline/Aqueduct (City of Boulder)
- Gross Reservoir Recreation Area (Denver Water)
- Walker Ranch Open Space (Boulder County)
- Golden Gate State Park (Colorado State Parks)
- Hunting Unit #29 north of Coal Creek Canyon (Colorado Division of Wildlife)
- Hunting Unit #38 south of Coal Creek Canyon (Colorado Division of Wildlife)

Alternative A – No Action

Direct and Indirect Effects of Alternative A (Recreation)

Short-term effects on the recreation resource will continue as observed in the past at the same frequency and intensity.

Cumulative Impacts of Alternative A (Recreation)

Recreational displacement and general recreation use dynamics have already adapted to the existing situation (fuels treatment projects). Predictable displacement norms would remain the same. It is unlikely cumulative effects would be measureable within or beyond the project area.
Alternative B – Proposed Action

Direct and Indirect Effects

Recreation users alike have expressed concern that burn piles (remaining unburned for long periods of time) encourage nuisance behaviors and illegal activities such as dumping of residential trash, unauthorized firewood collection which dispersed material and compromises pile stability, safety issues associated with people playing on the burn piles, and unsafe target shooting practices.

The effects of fuels treatment on the recreation resource would vary depending on the type of activity proposed. While fuels treatment units identified in the proposed action may take years to initiate, project work is expected take only months to complete considering unit layout, treatment type and annual funding. Therefore, only short-term direct effects to recreation users are expected when temporary closures of roads, trails, dispersed areas and developed parking areas are determined necessary, particularly in the vicinity of Nederland and the Gross Reservoir Recreation Area where recreation use is highly concentrated. Displacement is not measurable, and short-term impacts to the recreation resource are considered insignificant.

Cumulative Effects

With implementation of Project Design, there are no known cumulative effects associated with implementing Alternative B (Proposed Action).

Heritage

Applicable Laws and Forest Plan Direction

Section 106 of the National Historic Preservation Act of 1966 (NHPA), as amended, requires Federal agencies to determine if federally funded, permitted, or licensed activities would adversely affect significant historic properties (36 CFR 800). Cultural resources are considered historic properties if they are eligible for the National Register of Historic Places (NRHP). Determination of the eligibility of cultural resources, and the potential effects that undertakings may have on historic properties are conducted in consultation with the State Historic Preservation Office (SHPO), relevant Indian Tribes, and local governments.

According to the 2004 revised regulations [36 CFR 800.4(d)(1)] for the National Historic Preservation Act (16 U.S.C. 470f), sites considered not eligible for the NRHP may be directly affected once adequately recorded and evaluated, and concurrence is received from the State Historic Preservation Office regarding eligibility.

Methods and Indications

A total of 1350 acres have been inventoried for cultural resources within the Forsythe Fuel Reduction analysis area during the 2010 and 2011 field seasons. A cultural resource evaluation
consists of the following steps: the identification of areas that have a high potential for impact, the identification of known sites that are potentially eligible (needs data), eligible, or listed on the National Register of Historic Places and that are located within those areas determined to have high potential for impact, and the determination of areas that have not been previously surveyed but where significant sites are likely to occur. Survey objectives are normally limited to identifying specific site characteristics such as spatial limits, topographic setting, inferred activities, and temporal affiliations. All cultural resources are evaluated for eligibility to the National Register of Historic Places according to the criteria described in 36 CFR 60.4. All significant cultural resources must:

(a) Be associated with events that have made a significant contribution to the broad patterns of our past, or

(b) Be associated with the lives of persons significant in our past, or

(c) Embody the distinctive characteristics of a type, period or method of construction, or that represent the work of a master, or that present high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction, or

(d) Yield or be likely to yield information important in prehistory or history.

For the purposes of this analysis, cultural resources are considered significant if they are listed on the NRHP, determined to be eligible for listing on the NRHP, or if their eligibility has not been determined.

Affected Environment

Prehistoric Period

The full range of human occupation in Colorado arguably goes back to 15,000 years BP (Selby Site), although this is a matter of debate among archaeologists. Nevertheless, the Mahaffy Cache verified that human occupation has persisted in the Boulder area since at least 13,000 years ago. Diagnostic artifacts found near Barker Reservoir show connection to an Archaic occupation (Duncan-Hannah), while sites along Forsythe Canyon and Winiger Ridge show connections to the Plains Woodland Period. Nearby Ceramic Period sites litter the Walker Ranch complex adjacent to Gross Reservoir. The Ute occupied the area during the late prehistoric and contact periods, and, based on linguistic evidence, may have migrated to this area as early as AD 1300 (Miller 1986). The Arapaho, Shoshone, Cheyenne, and Kiowa also utilized the mountains of this area to a lesser extent beginning in the 17th and 18th centuries until the removal of all tribes in the late 19th century. Thus, the Forsythe project area lies in an area that has hosted continuous human habitation for at least 13,000 years, and includes lands that many Indian Tribes claimed as traditional homelands.

As subsistence hunters and gatherers, the Native Americans who inhabited the region migrated seasonally in search of resources. They followed game as they hunted it, and set camps near
plant resources that would be gathered. In search of mineral resources such as clay, tool stone, or minerals for paints, they traveled to wherever the materials might be located. This nomadic lifestyle required the widespread use of the region, but despite their extensive presence, relatively few sites are found in heavily forested areas. Generally, prehistoric occupations among nomadic peoples are short and often limited to small groups or bands using temporary or portable shelters. Unless the sites are left from large periodic aggregations, they are generally unobtrusive transient domestic camps, logistical hunting camps, or kill/butchering sites; thus, they are difficult to locate in heavy vegetation (especially given the historically developed landscape of the foothills of Boulder and Gilpin Counties.) In contrast, extensive early use of the region is evidenced in the high visibility areas in the nearby tundra along the Continental Divide, in the hogback ecotone, and in the plains. This is further supported by the presence of diagnostic artifacts found in the Winiger Ridge area that suggest a cultural connection between some of the high altitude sites and those found at the lower elevations. This suggests that unseen sites are not only possible but likely within the Forsythe area as it is located between prominent prehistoric sites at both high and low altitude. Forsythe Canyon is of particular promise given its array of crevasses and cliffs (commonly used in historical Ute burial practices.) This is further supported by the discovery of four prehistoric architectural sites as well as two open camps. Prehistoric isolated finds also have been located across the analysis area, further supporting the evidence of transient prehistoric use.

Investigations in the Forsythe project area have discovered a well intact isolated wickiup (5BL11446) close to two nearby prehistoric open camps (5BL7889 and 5BL11441). Wickiups are considered among the rarest of prehistoric sites in Colorado, thus this site is to be avoided by proposed treatment activities. The nearby open camps are also to be isolated from direct impacts from the proposed project.

**Historic Period**

**Fur Trapping**

In the mountains of north-central Colorado, the historic period begins in the 1820s when Euro American explorers first began to venture into the area. By the early 1840s, French and American Fur Trappers had entered the Forsythe area. (The more prominent character’s names are still found throughout the region, such as St.Vrain and Vasquez.) Series of log trading posts have been described along the drainages within the inner mountains and foothills (Bowles 1869); with the more substantial adobe forts located in the Plains along the Arkansas and South Platte Rivers. Unfortunately, the small scale of exploitation by explorers and trappers left little trace of their visits. Sites from this period are extremely rare and none have yet been located in the Forsythe analysis area.

**Mining**

The early mining period that first warranted the rush to the northern Colorado area began with the “Pikes Peak Gold Rush,” which led a number of placer miners into the front range of Colorado in 1859. Placer claims played out shortly and were quickly replaced with larger corporate facilities. Places like Nederland (Middle Boulder) and Magnolia were among the earlier investment mines, boasting large mills and other processing facilities, boarding houses, stores, offices, etc. Fluctuations in gold and silver values over the following decades, US
involvement in World War I, and the Great Depression caused the mining of the area to ebb and flow up until the 1930s. Some mines faltered due to a lack of workers, while others boomed such as Nederland and the neighboring mining camp of Tungsten due to the needs of war materials, specifically Tungsten. Consequently, the modern landscape still bares the scars of the extensive individual and corporate mining interests that dominated the area for over 100 years. Prospecting features dot the landscape, especially along the northern and western parts of the Forsythe analysis area. Other features related to the historic mining include irrigation ditches, shafts, adits, support buildings (e.g. head frames, hoists, etc.) and numerous concentrations of artifacts. Prominent mining hubs of the project area include Magnolia, Nederland, Tungsten, and Teagarden. No significant mining sites are within the proposed treatment area for the Forsythe Fuel Reduction Project.

**Transportation**

Many of the roads through the area were constructed to access the mines and facilitate shipment of ores and equipment to and from mining sites. One of the earliest and most prominent roads in the analysis area is the Boulder Canyon Road (5BL622), the original wagon road that provided access to the ore-rich foothills along Boulder Creek. Constructed in 1860 and rebuilt numerous times since then, the road still serves as a primary access route to the montane areas of Boulder County. Another significant transportation corridor in the analysis area is the Denver, Northwestern & Pacific Railroad (referred to by its later controlling company name Denver & Rio Grande Western.) Prior to 1904, Denver and many interior resources were locked away from any major railroad loops, restricting its appeal to larger commercial markets outside of the state. Seeking to remedy the situation, David Moffat financed the construction of the railroad from Denver into Boulder County, following South Boulder Creek until eventually crossing the Continental Divide at Rollins Pass. By 1905, the railroad was in operation, transporting cargo and tourists to and from Middle Park. On its way to Middle Park, the railroad also served the recreational tourism industry that began to develop in the eastern foothills. Places like Pinecliffe and Lincoln Hills benefited from the fast rail access from Denver into otherwise remote mountain settings. Segments of the railroad retain original features from the early 1900s and are considered significant historical properties. None of them would be directly affected by the proposed treatments.

**Water Development**

A concurrent but no less important theme in the development of the Front Range is that of water control. Within the Forsythe project area, there are three prominent water control features. The oldest and smallest is the Resumption Flume, a wooden structure located on the cliffs near Gross Reservoir. Constructed in 1896, the flume supplied water to the Alonzo Coan Resumption Placer claim. The second feature is the Barker Reservoir. Formerly “Barker Meadow”, the reservoir was built in 1908 to supply both water and hydroelectric power to the city of Boulder and numerous nearby mining communities. Gross Reservoir is a more recent addition to the reservoir system, being built in 1954. It is fed by the historic Moffat Tunnel which was built parallel to the railroad tunnel. In fact, the justification of the taxation of Denver residents for the construction of the railroad tunnel was for the purpose of the water control project and drawing off the Fraser River in order to supply Denver and Front Range communities. In the mid-1930s, Denver Water expanded and lined the water tunnel to increase the flow and provide greater water supply. The reservoir was eventually built to sustain the increasing population of Denver metro
area. The Resumption Flume, Barker Reservoir, and Gross Reservoir are significant cultural resources. The proposed activities would not adversely affect these water control features.

Previous surveys have also identified a historic shelter site (5BL7891) which does not fit into these prominent themes. The site is eligible for the NRHP and would be avoided by project activities per design criteria.

Environmental Consequences

Potential Effects of Proposed Activities

Alternative A – No Action

Direct Effects
Under this alternative no vegetation management activities would occur, no roads would be reconstructed or closed, and no prescribed fire would be used. This alternative would have no immediate effect on significant cultural resources. No mitigation or monitoring activities would be necessary.

Indirect Effects
This alternative would have no immediate indirect effects on significant cultural resources. However, the current beetle epidemic and associated accumulation of fuel wood would result in an increase in hazardous conditions in the project area. Dead and dying trees present a risk to historic structures when falling. Once on the ground, they present a secondary risk in the case of wildfire. While adding a benefit of obscuring artifacts from public view (thus reducing vandalism potential), the increased fuel load raises the potential duration, intensity, and heat penetration of a wildfire, which in turn increases the destructive capability of fires to both prehistoric and historic materials (NIFC 1995). In addition, measures taken to combat wildfires have a greater destructive potential given the urgency of operations over the controlled methods of prescribed fire treatment. For example, the use of retardants “on wall structures causes possible corrosion and contamination of subsurface materials (NIFC 1995).” Urgent placement of fire lines may cause undiscovered subsurface sites to be damaged or destroyed. This could result in the increased risk of loss of a number of cultural resources in the event of a wildfire.

Cumulative Effects
Archaeological sites are non-renewable resources that are being lost with an increasing frequency to alteration or destruction. The failure to address the increasing tree mortality and resultant accumulation of deadwood in the project area could subject an unknown number of undiscovered cultural resources to potentially destructive wildfires, thus reducing their contribution to the overall knowledge of our cultural heritage.

Alternative B – Proposed Action

Direct Effects
Several activities of the proposed action have the potential to impact cultural resources within the project area. The methods of clear cutting, harvesting, and thinning may use machinery that can disturb soils and subsurface cultural deposits. Road construction would also employ heavy
equipment for ground disturbing activities. Primary impacts to prehistoric cultural resources include the displacement, alteration, and destruction of surficial artifacts and cultural features, as well as disturbance to site soil deposition through mechanical ground disturbance with heavy equipment. Impacts to historic sites include the destruction of wooden structures and organic materials by means of fire, machinery or tree felling and the displacement and alteration of metal and glass surficial artifacts. The use of skid trails may disturb subsurface cultural deposits or earthen features. Pile burning of slash could result in severe damage or destruction of both historic and prehistoric materials if the pile is located on a site. Piles are concentrated and produce a long duration fire with high intensity, albeit localized.

**Indirect Effects**

Historic properties may be indirectly affected in numerous ways by the proposed action. One potential effect is the alteration of the visual characteristics of a landscape, resulting in changes to a site’s historic character. Altering viewsheds and other visual characteristics could adversely affect sites that are located on land other than those managed by the Forest Service.

The removal of timber also has the potential to indirectly impact cultural resources by increasing surface soil erosion. Exposure of subsurface cultural deposits could result in destruction of site stratigraphy, artifact displacement, and the deterioration of delicate organic materials. Exposure could also result in increased potential for vandalism due to the visibility of previously buried materials.

A positive indirect effect of the proposed action would be an overall reduction of the risk of long duration, intensive wildfires. Unnaturally heavy fuel loads from the previous policy of fire suppression has created a situation that is more precarious than in the past. “The buildup of fuels can be particularly damaging to archaeological resources of more recent age- late 19th century/early 20th century (Sturdevant 2011).” Given that the majority of cultural resources within the analysis area are from this time period, this produces a wide-scale risk. The removal of vegetation would reduce burn temperatures, fire intensity, and penetration of heat, thus reducing the destructive capability of fire when coming into contact with cultural resources.

Design criteria have been established so as to avoid adverse direct or indirect effects to historic properties.

**Cumulative Effects**

Archaeological sites are non-renewable resources that are being lost with an increasing frequency to alteration or destruction. The accumulated loss of numerous individual cultural resources has the potential to limit our understanding of broader patterns of human history essential to the overall knowledge of our national cultural heritage. Although sample surveys have been conducted, not all sites can be located and there is the potential that undiscovered sites could be impacted by project activities. The proposed activities have the potential to impact individual cultural resources with various mechanical vegetation treatments and use of fire.
Irreversible or Irretrievable Commitment of Resources

Cultural resources are non-renewable, but the project has been designed so as to avoid adverse effects to significance cultural resources per 36 CFR 800.
Chapter 4 - Consultation and Coordination

The Forest Service contacted, consulted, and scoped with the following individuals, Federal, State, and local agencies, and tribes during the development of this environmental assessment.

Interdisciplinary Team Members

List of Preparers

Sylvia Clark
District Ranger - Decision Maker, Responsible Official

Dave Park
Acting District Ranger – Objection Period

Trey Schillie
Acting District Ranger – EA compilation oversight - Bachelor of Arts in Geography from the University of Missouri in 1997 & Masters in Environmental Management from the Yale School of Forestry in 2003. Held various positions in eight years with the Forest Service on two National Forests, one Regional Office, and the Washington D.C. Office.

Marcus Staley
Acting District Ranger - Project Initiator- Bachelor of Science in Civil Engineering & Masters in Civil Engineering Structures from the University of Florida in 1998 and 1999. Three years engineering design experience with a consulting firm in Florida. Nine years in engineering with the Forest Service on six National Forests, three National Grasslands and one Regional Office in the Pacific Northwest and Rocky Mountain Regions. Fire experience includes basic wildland firefighter training, minor incident support roles and designer for fire support facilities across the country.

Cody Hutchinson
ID Team Leader, Writer/Editor, Silviculturist, Socio-Economic Analysis. Bachelor of Science in Forestry, Forest Resources Management Emphasis, University of Montana, 2002. Forest Service Certified Silviculturist. Thirteen years experience at district level in timber sale preparation, timber sale administration, silviculture, fire and fuels management on three National Forests, one National Grassland, and six Ranger Districts in the Rocky Mountain Region. Fire experience includes: ten years of wildland and prescribed fire experience as a firefighter, squad boss, engine boss, Type 5 Incident Commander, and dispatch.

Elsha Kirby
Public Affairs - Bachelor of Science in Environmental Studies from Utah State University, 2004. Ten years Forest Service experience working in varied fields including fire, trails, public affairs, and public and governmental relations. Served in public affairs in district, forest, and regional offices on four different National Forests in four different Regions. Fire experience includes Type II firefighter and Public Information Officer.
Cambria Armstrong  Fire/Fuel and Air Specialist - Graduated from Colorado State University in 2001 with a Bachelor's Degree in Forestry with an emphasis in Fire Science. Ten years of fuels planning experience on the Arapaho-Roosevelt National Forest and Pawnee National Grassland. Sixteen years of experience in wildland firefighting and prescribed burning. Fire experience includes time as a firefighter, assistant engine captain, helicopter crewmember, fire effects monitor on broadcast burns, agency representative, initial attack dispatcher, expanded dispatch recorder, airtanker retardant loading crewmember, and wildland fire investigator.

Deanna Williams  Wildlife Biologist - Bachelor of Science in Natural Resource Management, Masters of Science in Wildlife Ecology. Twelve years' experience as a Forest Service Wildlife Biologist in Fuels Planning, Habitat Restoration, Recreation and Special Uses, and Education and Outreach across two regions and three forests.

Amy Coe  Bachelor of Science Degree in Applied Biology with a concentration in Wildlife and Restoration Ecology from Arizona State University. Graduate coursework in Plant Taxonomy and Ecology at Arizona State University. Worked as a Rangeland Conservationist at a District on the Tonto National Forest performing rangeland inventory and monitoring, vegetation mapping, riparian monitoring, and as the District GIS support from 2007-2010. From 2010 to present, worked as a GIS Specialist in the Supervisor’s Office both on the Tonto National Forest and now for the Arapaho Roosevelt National Forest & Pawnee National Grassland. In both locations, performed database administration, data analysis, project data generation and management, and various mapping efforts, as well as providing GIS support to the Boulder and Clear Creek Ranger Districts. Certified as a GISS for fire/incident support, as well as a certified Para-Archaeologist.

Judy Kittson  Civil Engineer, Transportation and Roads - New Zealand Certificate In Engineering Civil Option (equivalent to Bachelor of Civil Engineering), Licensed Professional Engineer # 33035 State of Colorado. Twenty five years engineering consulting, project and design experience in the private industry working on public and private infrastructure, utility and construction projects. One year as civil engineer for the Boulder Ranger District with the Forest Service supervising construction project, designing road and drainage improvements and providing engineering expertise to the district staff.

Mike Johnson  Realty/Lands Specialist - Bachelor of Science in Forest Management from Oklahoma State University in 1990. Twenty-one years of experience at the District level in Silviculture, Sale Administration, Sale Preparation, and Lands and Minerals on three districts in two Forests and two Regions.
Kevin Colby
Landscape Architect/Scenery – Bachelor of Sciences from the State University of New York College of Environmental Science and Forestry at Syracuse and post graduate studies at Colorado State University (CSU) in World Resources. A visiting lecturer at CSU. Published nationally and internationally in professional journals. Worked for the Forest Service for 33 years. Fire experience includes wildland firefighting training, wildland fire behavior and incident support roles.

Bev Baker
Noxious Weeds Specialist - M.S. in Wildlife Management from Colorado State University in 1994. 20 years with the USFS, the past 17 years at the Boulder Ranger District (BRD), analyzing impacts to wildlife and sometimes plants for a variety of projects primarily in recreation and lands, and participating in restoration projects to improve wildlife habitat. Managed invasive plants since 1999. Provided input to a variety of projects in recreation, lands, and fuels regarding prevention of invasive plant introduction and spread. Basic wildland firefighter training; Resource Advisor for Fourmile Canyon Fire in 2010.

Ed Perault
Recreation Specialist - Bachelor of Science in Recreation (Parks and Natural Resource Management), minor Business Administration, California State University, Chico (Summa Cum Laude), 1990. Nine years experience as Supervisory Biological Scientist - Recreation Staff Officer with the USDA, Forest Service, Boulder Ranger District. An additional twelve years experience on Forest Service and Bureau of Land Management units as recreation planner and team lead on various recreation/resource management plans and related NEPA efforts. Regulatory compliance and Fire experience includes Wildland Firefighter II, Fire Information Officer, Contracting Officer Representative and Forest Protection Officer certifications.

Paul Alford
Archaeologist - Received a Bachelor of Arts degree in Anthropology in 1998 from the University of Colorado. Received a Master of Arts degree in Archaeology and Heritage in 2004 from the University of Leicester. Worked for various contract archaeology companies along the Front Range of Colorado and the plains of Wyoming. Nine years of experience in cultural resource management on the Arapaho and Roosevelt National Forests and Pawnee National Grassland. Research areas include Plains and mountain prehistoric complexes, and mountain historical archaeology including extractive industries such as precious metal mining, and logging, as well as commercial and recreational developments.

Carl Chambers
Hydrologist – Bachelor of Science in Watershed Management, Utah State University, 1984. Twenty-six years experience in forest hydrology and watershed management on three National Forests in the Intermountain and Rocky Mountain Regions. Twenty years experience as Burned Area Emergency Rehabilitation (BAER) leader and hydrologist.
Steve Popovich  Botanist - Bachelor of Science, 1985, and Master of Science, 1989, in Range Ecology with Botany concentration from Colorado State University with a Minor in French in 1989 with post college work at Montana State University and Washington State University on habitat types and system ecology. Twenty-four years of experience with the Forest Service, BLM, and National Park service in Colorado, Idaho, Montana, and Oregon in Range Research, Ecology, Botany, and Weeds Management, and Range Management. Work on a variety of NEPA projects throughout career, completed international assignments, wrote many papers about botany, and spoken at universities across the country on the role of government in managing natural resources. Fire experience includes Type 1 and Type II Team Overseer member, hand crews, Logistics Chief, fire rehabilitation, prescribed burn monitoring, fire modeling, weed seed monitoring for fire rehab.

Matt Fairchild  Fisheries Biologist - Bachelor of Science in Wildlife and Fisheries Science with Forestry minor from the University of Tennessee in 1998. Master of Science in Aquatic Ecology from The Ohio State University in 2001. Certified Fisheries Professional, current and in good standing through the American Fisheries Society. Ten years experience as a fisheries biologist analyzing and documenting the impacts of land management projects, including myriad vegetation projects from timber sales to hazardous fuels reduction to timber stand improvements on Bureau of Land Management and Forest Service Units across the varied terrains of Oregon, Idaho, Washington, Utah, and Colorado. Fire experience includes Basic Wildland Firefighter credentials from 2002 to present as well as Resource Advisor for fire events and a member of Prescribed Burning Teams.

Eric Schroder  Soils and Air Quality – Bachelor of Science in Soil Science with emphasis in Land Resources Management, California Polytechnic State University, 1994. Fifteen years experience on four National Forests and one year with the USGS Water Resources Division. Experience includes identification and description of impacts to forest and rangeland soil and water resources, watershed restoration projects, assessment of burned watershed conditions on many western US national forests, wildland fire suppression and support roles, prescribed fire implementation and assessment.

Kevin Zimlinghaus  Project Implementation – Bachelor of Science in Natural Resource Management with an emphasis in Hardwood Management, California Polytechnic San Luis Obispo, California, 1987. Certified Silviculturist for the Forest Service in two regions since 2002. Twenty-five years experience in three different Regions and four National Forests, in the following fields: Silviculture – program management at both the Forest and District/Zone level for fuel’s reduction, mountain pine beetle, reforestation, and timber stand improvement contracts; Timber – program management, sale
preparation and contract administration; NEPA – Silviculturist, ID Team Leader, Writer/Editor, and Economic Analysis; Fire Suppression and Management (over 12 states including Alaska) – wildland fire suppression on both an engine and inter-agency hotshot crew as a squad boss, crew boss, dozer boss, and display processor; prescribed fire including large scale broadcast burns and pile burns.

**Colin Hutten**

Project Implementation - Bachelor of Science in Forest Management, University of Wisconsin – Stevens Point, 2001. Eleven years experience at district level in timber sale preparation, timber sale administration, fire and fuels management on five National Forests in three different regions (Rocky Mountain, Southwest, and Pacific Southwest). Contract/sale administrator and pre-sale forester for fuels reduction projects and timber sales. Fire experience includes wildland firefighter, helicopter crewmember, engine crewmember, and prescribed fire.

**Will Briggs**

South Zone Fire Management Officer - South Zone Fire Management Officer- UNLV Biological Sciences for Land Managers 2007. Seventeen years experience in wildland fire management, seven years in New Mexico with Bureau of Indian Affairs and Bureau of Land Management, eight years in Idaho with the Bureau of Land Management and one year with US Fish and Wildlife Service in Colorado. Fire experience includes crewmember and squad boss on an Interagency Handcrew, member of a Fire Use Module, crewmember, engineer and captain on Type 6 and Type 4 Engine Crews and six years as a Fire Operations Specialist. Served on Type 2 and Type 1 incident Management Teams as a Division Group Supervisor. Qualified as an Incident Commander Type 3, Division Group Supervisor and Type 2 Prescribed Fire Burn Boss.
Federal, State, and Local Agencies

Colorado State Forest Service
Colorado Division of Wildlife
Boulder County Parks and Open Space
County of Boulder
County of Gilpin
City of Boulder
Town of Nederland
U.S. Fish and Wildlife Service
Colorado State Historic Preservation Office

Tribes

Cheyenne and Arapaho Tribes of Oklahoma
Northern Arapaho Tribe
Northern Ute Tribe
Northern Cheyenne Tribe
Southern Ute Tribe

Others

Colorado Congressional Delegation
Off-Road Organizations
Local Residents
Private Citizens
Environmental and Ecological Organizations
Local Residential Developments and Associations
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